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GREAT TRACTION DEVELOPMENTS.

The public of Greater New York is at present more impressed with the fact that preparations are being made to provide it with the new rapid transit facilities that it needs than with the not less striking fact that all the work in question depends upon electricity. We print elsewhere a summary of Mayor Low's admirable locution on the subject of the transportation problems of Manhattan Island, and it is curious to note even there how the speaker harks back constantly to what electricity is going to do, without being conscious apparently that but for electricity, the problems would be approached, and would have to be solved, in very different fashion. The same is true of the Chicago aldermen who have been in New York lately, investigating subways and systems, and have evidently gone home impressed deeply with the idea that their great city must have an equal share in the benefits that, apparently, electricity alone can confer on modern centers of dense population.

Electricity is indeed the keynote, and every electrical engineer is stimulated at once by the magnificent opportunities of new work thus presented, as well as by the confident manner in which the leading and most progressive communities of the Old World and the New lay these burdens and responsibilities upon his shoulders. With these pending changes accomplished, the age of steam, cable, air and horse will have definitely closed in urban transportation, and electricity alone will reign exclusively and supreme. And while this means much to the electrical engineer, it means not less to the art and industry; for even with the existing outlook it is impossible to conceive how the plant and apparatus required can be furnished without large additions to manufacturing facilities already inadequate to meet the demand.

So far as New York is concerned, it is well enough; but there is involved a great gain to the traveling public at large. Not only is the Pennsylvania Railroad committed to the adoption of electricity, but the New York Central has reached the point where it breaks away from an ancient regime and adopts the newer motive power, with all that is implied in so serious and momentous an improvement. It would indeed have been an intolerable anachronism for the filthy old Park Avenue tunnel to continue operated by steam while other trans-continental accesses and all the local subway routes were being traversed by means of electricity; and it is interesting to note that having once determined to adopt electricity terminally, the New York Central avows itself ready to utilize the same agency for its large suburban business. In fact, that change was again consequent and inevitable; but it is better to have it come as part of a systematic and scientific programme than as a slow and piecemeal revolution keeping things in confusion over a long series of years. That the change again may involve, through the use of common electrical methods, a close alliance between New York Central and the Manhattan Elevated system, is by no means improbable; is, indeed, strictly logical.

GERMAN ELECTRICAL STANDARDIZATION.

Following in the wake of the American Institute of Electrical Engineers, the Association of German Electrical Engineers appointed a standardization committee last year to draw up a set of rules relating to the testing and classification of electric machinery. The committee presented its first report in 1901. This year an extended and more complete report has been accepted, which bids fair to be officially adopted in Germany in the near future. It is interesting

to notice the resemblances and differences between the reports of the German and American standardization committees. They follow the same general lines, commencing with definitions and ending with a table of voltages; but the differentiations are of the greater interest.

Among the German definitions is that of "starvoltage," as distinguished from the simple "voltage" of a three-phase system, and is the voltage between any terminal and the neutral point. This term would be very acceptable in our own general use. A seemingly useful German classification of machinery with respect to service is that of

(1) Intermittent service, to which one hour's full load test is applied.

(2) Short-period service, to which a specified period of load test is applied.

(3) Continuous service, to which ten hours of load test is applied. In the American rules there are only two classes: that of continuous service tested for a sufficient period to attain a close approach to final temperature, and that of discontinuous service, tested under specified conditions. The necessity for the third class does not appear to have presented itself in American practice. The methods of measuring the temperature elevation of machines follow the same lines in both reports, but are somewhat more detailed in the German schedule. The new American rules are somewhat more precise, however, in the application of the temperature coefficient of resistivity in copper.

It is curious to observe that the German rules specify that mechanical power should be measured in horse-power. This seems to be deplorable, although on commercial grounds it may be temporarily condoned. It is to be hoped that in all countries the kilowatt will displace the horse-power as the unit of power. There is no necessity, beyond that of commercial conservatism, for retaining that crude and meaningless unit of activity, the "horse-power." Two frequencies also are recommended in the German report for alternating-current circuits; namely 25 and 50 cycles per second. This is an improvement over the American rules, which still recommend three, namely, 25, 60 and 120 cycles per second.

It is interesting to observe that the high-pressure testing voltages are similar in the two schedules, the American rules being somewhat more stringent. Above 20 kilovolts of normal working pressure, both call for a testing voltage of 50 per cent. extra. It is to be hoped and expected that every civilized country will elaborate a set of standardization rules for itself; and that, following upon the confusion which would thereafter be likely to ensue, an international convention may ultimately be called, at which a single set of rules may be selected for universal use all the world over. This achievement will, however, probably take time to effect.

LONG DISTANCE TRANSMISSION BY CONTINUOUS CURRENTS.

It is so seldom that we hear about the transmission of power by direct currents, that a novelty of this sort is refreshing. At one time it was fairly common to find direct-current series motors of small capacity operated from constant-current series-arc circuits. Now it is comparatively rare to find a constant-current motor. The transmission plant from St. Maurice, on the Rhone, to Lausanne, Switzerland, a distance of about 35 miles, employs the constant-current system at a total pressure of 23 kilovolts. At the generating station there are five 1,000-hp turbines, each turbine driving a pair of D. C. generators of 150 amperes and 2,300 volts maximum. All the ten D. C. generators are connected in series to produce a total maximum of 23,000 volts. The disadvantages of a system of this sort are the high electric pressure brought to bear upon the insulation of each generator in the series, the danger of flashing at commutators, and the reduced plant efficiency of the copper in the transmission lines; since in the three-phase system of the same voltage betwen wires the copper could be reduced 25 per cent. The advantage of the system is its great simplicity. There is no necessity for a switchboard. The power transmission plant virtually becomes a series arc-light plant of relatively large current, and with a relatively large number of series generators.

Under special conditions, and with careful installation, there seems to be no reason why such a plant should not be more convenient and economical than a three-phase plant of the same capacity. This only shows that it is not safe to conclude that one particular system cannot serve a certain purpose; merely because it is the almost universal custom to adopt another system for that purpose. It is likewise proverbial that there are always alternative methods for exterminating an ordinary specimen of the feline race.

In connection with the same system, a Thury direct-current dynamo is stated to have been built for 25 kw at one ampere and 25 kilovolts. This seems to be by far the highest direct-current voltage obtained from a single commutator. We are familiar with series-arc dynamos, which develop a terminal e. m. f. of ten or even twelve kilovolts; but this pressure has been looked upon as the limiting value. In the Lausanne generator the average e. m. f. between commutator segments is about 500 volts, and means are described for applying an air-blast to the brush contacts on the commutator, on the principle of the blower in the Thomson-Houston arc dynamo.

Although this is a great achievement in its way, and a direct-current dynamo of 25 kilovolts would be a useful machine in various applications, it seems doubtful whether the commutators of such machines could be trusted to operate continuously for months and years without breaking down in insulation. A single failure of the blower, for a few moments, might cause a disastrous arc to be established around the commutator. It is true that high-pressure D. C. arc generators operate satisfactorily; but their current delivery is limited to ten amperes. The commutation difficulties and dangers tend to increase with the current delivered by the machine. The Lausanne transmission plant is certainly unique, and its operation will be followed with interest. It is important to ascertain under what conditions and limitations a high-pressure, direct-current plant is superior to a high-pressure alternating-current plant. If commutator difficulties were eliminated, there can be no doubt that the range of direct-current systems would be greatly increased.

HIGH-TENSION SWITCHING.

As we have had occasion to remark in our columns several times previously, the tendency of practice around high voltage transmission plants, and especially those in the far west where the most experience has been had with handling extremely high voltages, has been toward doing as little switching as possible on the high-tension lines. It has come to be rather generally accepted among transmission engineers on the Pacific Coast that switching, as far as possible, had better be done on the low-tension side of step-up transformers, leaving the high-tension switches to be opened only in case of absolute necessity. To those who have been educated to this idea, the new practice being introduced in several very recent plants of doing all switching on the high-tension side of step-up transformers, is little short of startling at first thought. In these recent plants, each generator is considered as a unit with its bank of trans-

formers, the generator being connected directly to the low-tension coils of the step-up transformers. That such an arrangement simplifies immensely the work of switching around a high-tension transmission plant and also equally simplifies the switchboards and electrical connections, cannot be denied. Where the switching is done on the low-tension sides of the step-up transformers, there must be switches not only for the low-tension circuits between the generators and transformers, but also for the high-tension circuits, because it is necessary to disconnect transformers from the high-tension bus-bars. The successful operation of a plant doing all its switching on the high-tension side of 26,000-volt transformers would have been out of the question three years ago because of the lack of high-tension switches capable of surely breaking circuits of 14,000 volts and over.

The usefulness of the oil switch for breaking high-tension circuits has been greatly increased in the last few years, however, and it is maintained by those who should know that the handling of a 26,000-volt circuit with oil switches is as certain as handling the 6,600 and 11,000-volt circuits on which the oil switch has been in use for some time. As a large manufacturing company is not likely to install and guarantee apparatus calling for a large expenditure of money and involving the reliability of immense power houses without experimental data demonstrating the correctness of faith in the oil switch for breaking high potentials, there is no good reason to fear the outcome of this new practice. Some questions do, however, arise as to the static strains on high-tension lines suddenly opened in this manner. This is a question which has been thoroughly analyzed and discussed during the past year in papers by Messrs. Steinmetz and Baum; and danger from this source is, perhaps, feared more generally than before on this account. Whether or not this will prove serious in this connection will manifestly depend on whether the transformers used are built to stand much in excess of the normal working potential. As most of the transformers used on high-tension transmission lines are built to stand this excess potential there will probably be little trouble until voltages are reached which approach the limit of possible transformer insulation.

A STUDY OF ELECTRIC PUMPING.

Mr. Bowie's paper on electric pumping for irrigation, in this issue, throws much light on a subject over which rule of thumb has consistently reigned for an indefinite period. The perspiring dweller in the East in particular has very vague notions as to what irrigation really means in the evaporated West. The only mental picture which it calls before his consciousness is that of the optimistic suburbanite officiating with a garden hose over the gravel patch for which he still entertains lingering hopes. The conception of a barren, dust-blown country suddenly converted into a garden spot of boundless fertility by a careful wetting-down is a new one to him. Hitherto irrigation in the West has been the result of elaborate ditch systems involving great engineering works and very large investments of a sometimes precarious character. The material results have been magnificent, but the benefits of the system have been somewhat limited by the single question of cost. Obviously, it does not pay to occupy lands where irrigation is very expensive, until more favored localities are pretty thoroughly settled, and the irrigation works always have to keep in advance of settlement, for the self-evident reason that farmers will not settle in an unirrigated desert. Hence there is at the start a speculative element about irrigation works which has led to some conspicuous successes and to some pathetic disasters.

Irrigation from wells is quite another matter. It is a case for the enterprise of the individual. A group of wells can be put down on comparatively short notice, and ordinarily without great expense; at least one would not attempt to make a large investment of this kind unless the end justified the means. With reasonably cheap electric power, water can be raised from wells quite cheaply and rendered available for irrigation. But it must not be for a moment supposed that such is the whole of the story. Lifting the water is the smallest part of the problem. In theory, it requires only about 3,000,000 pounds of water to flood an acre a foot deep, and from a well 50 feet deep or so, the power required thus to flood the dry earth by steady pumping 24 hours per day amounts to very little. Ten horse-power would probably take care of a good many acres in the ordinary course of irrigation. But the very land which most needs irrigation needs it because it does not hold the moisture but lets it drain through to the lower strata. Hence, when the land is nicely arranged for irrigation the water sinks through the soil about as fast as it can be pumped—it is like trying to fill a bottomless pitcher—and if the water has to flow far from the pumps it flows downward instead of outward. The actual size of the motor pumps is determined not by the total water required to properly wet the surface, but by the rate of flow which is necessary to distribute the water at all. Mr. Bowie's advice regarding cemented ditches is excellent. These might well be supplemented by small wooden distributing flumes, carrying thus within the limits of a single ranch the general methods of the big ditch companies. When the water supply is good enough to insure freely-flowing wells without going to a prohibitive depth, the pumping scheme would seem to be an excellent one. But wells are notoriously uncertain things to locate. We recall one instance of a determined individual in California, who plugged down 1,400 feet after water, and then gave up in disgust. And even after one well is successfully located, as Mr. Bowie points out, the sinking of a few more may exhaust that particular vein of water. If one could chart the subterranean rivers and lakes, rills and morasses, it would be a curious map indeed that would result.

All in all, the pumping plan for practical irrigation is rather of a local than of general applicability, and points strongly toward intensive farming, a line of agricultural operations comparatively little practiced in this country. But still it has a good field for usefulness, and the power transmission companies find in these irrigation pumps a useful and profitable load. The fixed investment of a transmission plant requires a good load factor to insure economical running, and a pump load which can be cut off at the peak is peculiarly useful in building up a good load factor. From an engineering standpoint the practice is interesting as requiring for its economical administration a very reliable class of motor-driven pumps and accessories. And as has already been discovered, it is no light thing to make machinery of this kind run twenty-four hours a day without attention. Machinery laid out for ordinary work breaks down here, and extraordinary precautions have to be taken to insure continuity of operation. Even the question of heating takes on a new aspect under the fierce Western sun. In particular, where natural ventilation of transformers is depended upon it makes a very material difference whether the initial temperature of the air is 80 degrees or 110 degrees, and data on the performance of apparatus under these high external temperatures are scarce. Hence, there is every occasion for extreme watchfulness in the pumping installations, and it would be well if those who build the apparatus would study the engineering side of the problem carefully on the ground, and with a keen eye to future developments. There is a vast deal of irrigation to be done, and it may be that a skillful combination of natural and artificial supply would materially reduce the costs. Above all, the methods of water distribution need close watching and shrewd improvement, for the crude methods of the past will not do when the water has to be pumped.

Mayor Low on Electric Traction Around Manhattan Island.

In the course of a carefully prepared paper or written interview, Mayor Low, of Greater New York, discussed, last week, the many electric railway problems and projects now awaiting settlement, the two main points treated being interborough communication between Manhattan Island and Long Island, and communication with Manhattan from the north. As to Brooklyn Bridge, he advocates rebuilding the suspended structure, and says:

"When the Brooklyn Bridge was designed, it was intended, from the railroad point of view, to be a bridge with shuttle trains passing to and fro upon it. In the process of time, it has become a railroad thoroughfare—wholly so as to trolley cars, partly so as to the bridge railroad proper. One need not be a prophet to be able to foresee that its destiny is to become, from this point of view, wholly a thoroughfare. Two conclusions follow from this situation: First, that the suspended structure of the Brooklyn Bridge should be rebuilt as soon as possible, to adapt it to the largest possible use as a railroad thoroughfare; second, that all the other East River bridges must be treated as railroad thoroughfares—that is to say, they must not only arrive; they must lead somewhere. These conclusions may be briefly amplified. There are certainly very few, if any, railroad bridges in the country, 20 years old, that have not been rebuilt, at least once, in that interval, and, in some instances, twice, to adapt them to the demands of modern use. The towers of the Brooklyn Bridge and the cables and anchorages of it are equal to any demands that may be made upon them, but the suspended structure cannot do any more than it is doing now. Were this suspended structure to be rebuilt to comply with modern conditions, six-car trains could be run instead of four-car trains; in other words, the train capacity of the bridge could be increased 50 per cent. I believe this work can go forward without interfering with the use of the bridge. It ought to be planned for at once, and put under contract as early as possible. The estimated cost is $2,000,000. With this work completed, we should have a modern railroad bridge instead of one 20 years old."

Referring, incidentally, to the moving sidewalk idea, he says: "I think it is true that a moving platform would carry double the number of people of the present bridge railroad, but it would be reverting to the old idea of the bridge as a thing complete in itself, instead of as a railroad thoroughfare. Neither do I think it good judgment, if it can be avoided, to abandon, even temporarily, a single fare between the boroughs. I am quite confident that the moving platform should not be resorted to, except in case of necessity or except in response to a popular demand. The part of wisdom, I am sure, is to go ahead with the plans for permanent relief as soon as possible."

Coming to the northern problem, Mayor Low remarks: "The key of this situation, so far as it is an unsolved problem, is the New York Central and Hudson River Railroad. It is a fortunate thing that no legislation affecting the Grand Central Depot was had last winter, for legislation hurriedly prepared and passed under pressure of a feeling of panic can seldom be sufficiently matured to deal wisely with such a problem. When the Legislature was in session, the New York Central Company was under the impression that it could not undertake to change the motive power of its through traffic from steam to electricity for many years to come. It advocated, then, plans for a change of power for its suburban traffic, which called for a loop under Madison Avenue and various other streets.

"Since the adjournment of the Legislature, I have kept in close touch with this question, and I am now authorized by the president of the New York Central Railroad to say that his road is ready to enter into a stipulation with the city, if the city will approve the changes which they now wish to make at the Grand Central Depot, to substitute electricity for steam, not only for their suburban but also for their through traffic; and that they will sign a contract for erection of power houses adequate for both of these purposes, immediately after the approval by the city of their terminal plans.

"Nor is this all that has been gained by a more careful study of the problem. In response to my suggestion that there ought to be some point or points in the Borough of The Bronx at which passengers could change from their suburban and through trains to the subway and to the various elevated roads running south, the company has given me its assurance that the city can command its most earnest and energetic co-operation in developing such a center, or centers, as may be deemed best, north of the Harlem River.

"This matter will be brought before the proper boards for action in September. The city has ample power, under the charter, to do a large part of what is asked. If more power is necessary to complete the work, that can be had next winter by enlarging the powers of the city, instead of the railroad. This will avoid the difficulty of passing a general law to deal with a very special situation. The railroad company must, of course, get legislative authority to change its motive power from steam to electricity, but there is no doubt that this authority can be had for the asking. A law should also be passed, which was overlooked last winter, compelling the New York, New Haven and Hartford to make the same change, so far as it continues to use the Grand Central Depot."

With regard to the mayor's remarks, Vice-President Brown, of the New York Central, states that the company has demonstrated that electric motors can be made of sufficient power to draw the trains of the suburban service, and that the project for a loop under the Grand Central Station will be proceeded with. The total cost of the projected loop and new lines will reach $10,000,000.

Another Electric Traction Tunnel for New York.

Frederick B. Esler, president of the New York and Brooklyn Railroad Company, states that the plan of the new tube tunnel from New York to Brooklyn, in imitation of the two-penny tunnel of London, and which was first spoken of in 1896, is about to be begun. J. H. Hoadley, of the International Power Company, and G. S. Drummond, of the Manhattan Transit and British Traction Company, are on their way from London to New York, with a view, as Mr. Esler states, of beginning promptly the physical work of construction. His explanation of the development of the scheme and its present status is as follows:

We have the franchise permission from the Railroad Commission to proceed with the work, and, in fact, are in a position to go ahead with the work without any legal barrier. The plan of building the tunnel is being underwritten by a syndicate, of which Lord Kintgore is the chairman. The other members of this syndicate are Earl Grey, Sir Charles Rivers Wilson, and Washington Hume. The men who propose to build the tuunel are G. S. Drummond and J. H. Hoadley. Our franchise gives us permission to build a tunnel from Park Row to the dock line of Brooklyn. Efforts were made to get the franchise ratified by the Municipal Assembly, to which Brooklyn objected. Nevertheless, as the city has been extended, including Brooklyn, our franchise was also extended.

The tunnel will have a double track, and will be entirely fire-proof. James Stewart, of the Westinghouse Electric Company, has been spoken of for carrying the work through to completion, but he is not yet fully decided upon. There will be three entrances and three exits, so far as we know now, on each side of the river. We will connect with no road whatever, but will merely transport passengers under the river. So far as we know now, the fare is to be three cents, but that may be altered. The fact that the recently arranged for tunnel will cross under the river at pretty nearly the same spot at which we hope to cross will make no difference to us. We cannot yet tell what the exact cost of the road will be. About $6,000,000 is ready for use. It is to be finished by July 16, 1904. We are now buying property at both sides of the river for entrances and exits. The tunnel will be almost precisely like the two-penny road of England. The deepest point of the tunnel will be 98 feet under the water level.

Traction in New York and Chicago.

Note was made in our pages last week of the visit to New York of a special committee of the Chicago City Council, appointed to investigate subways, traction development, etc. One or two opinions cited by the Chicago newspapers would indicate that that city may soon be launched on a career of traction development as extensive as that now proceeding on and around Manhattan Island.

"Surface street railways here," said Alderman Foreman, "should be operated as they are in New York, as one system, and the same company should operate cars in a subway, which under all circumstances must be owned by the city.

"New York and Boston do not seem to hold to the theory that in order to be prosperous a city must be dirty. New York is experiencing a degree of prosperity without example in this or any other country, and in spite of prosperity has clean streets and pure air."

Missouri River Power Company's 50,000-Volt Transmission Plant.

BY A. W. CLAPP.

AS noted in the ELECTRICAL WORLD AND ENGINEER of March 15, the Canon Ferry, Montana, generating station of the Missouri River Power Company early in the year began the supply of current at 50,000 volts for transmission to Butte, 70 miles distant. Since that time the plant has been supplying current continuously to Butte, being thus the first plant in the world to operate normally at such a voltage. The Canon Ferry plant, which was completed in 1899, was described in the issue of July 13, 1901, of this journal, and some of its constructional features were the subject of an article in the issue of June 7, 1902. Since the earlier articles a number of improvements have been added, of which it is the object of this article to give some account, as well as of the new Butte substation.

As stated in the previous description, the power house at Canon Ferry is a rock-faced granite building 225 x 50 feet inside and 28 feet in the clear below the roof trusses, with a steel and concrete arch gallery along the west side 17 feet 6 inches wide and 13 feet 6 inches clear below the roof trusses. This gallery also extends across the north end of the power house, affording ample room for offices, etc. All of the space between the edge of this gallery and the east or river side of the house is covered by a 15-ton crane, furnished, as was all the steel work, by the American Bridge Company.

Penstocks beneath the gallery enclose the pairs of turbines, which are direct-connected to the generators, both being carried on I-beams across tail races 15 feet wide by 12 feet deep, formed by granite walls 5 feet thick, spaced on 20 feet centers. On the west side of the main power house a steel and corrugated iron addition 156 feet long, occupying the space between the power house and the canal wall, and having its floor just above the penstocks and on a level with the gallery floor, affords room for the six 950-kw transformers mentioned later.

The original installation consisted of four two-phase, 750-kw, 550-volt generators, direct-connected to pairs of Dayton Globe Iron Works turbines, three of these being controlled by Replogle governors, and the fourth by a Lombard governor. There were two 90-kw, 125-volt exciters direct-connected to separate turbines. From a white marble switchboard with four sets of busses the current was carried from four transformer panels over sixteen 1,000,000-cm., lead-covered cables to a separate transformer house, where there were eight 325-kw transformers, oil-insulated and self-cooled, in four sets connected to transform from 550 volts, two-phase, to 11,000 volts, three-phase. At this pressure the current passed through a plug-board Westinghouse lightning arrester, and into four feed lines of No. 4 solid copper which led to another plug board of similar construction at East Helena, and from there to the company's various services in and around that city.

The changes and additions recently made include the moving of these transformers and plug boards on the main gallery of the power house and the arresters into the addition; the purchase of four more transformers of the same capacity, and the changing over from the old switchboard to an entirely new one. The four generators were also changed from two-phase to three-phase by the addition of brass fish-plates to stiffen the laminations at each end of the armature, and the substitution of new ventilated type, three-phase collector rings for the original two-phase rings. The new apparatus installed consisted of six three-phase, 750-kw, 550-volt Westinghouse generators, direct-connected to pairs of 45-in. turbines, furnished by S. Morgan Smith Company, York, Pa.; one 225-kw, 150-165-volt exciter connected to another turbine; seven Lombard governors and another exciter of 150-kw capacity driven by a 150-hp, 550-volt induction motor. There were also installed six 950-kw, 550-50,000-volt transformers, together with 12 static interrupters, six lightning arresters, fused circuit-breakers, etc., at Canon Ferry, and a duplicate equipment in the Butte sub-station. These 12 transformers can all be connected with 550-volt or 2,200-volt to 25,000-volt or 50,000-volt, and are supplied with extra strips for adjustment to meet running conditions.

FIG. 1.—GENERAL VIEW OF CANON FERRY POWER PLANT.

The main switchboard at Canon Ferry is 47 feet 4 inches by 9 feet 9 7-16 inches high, of blue Vermont marble, finished in polished copper and black enamel, and is located centrally on the gallery. At the left of the board are six 325-kw, 550-11,000-volt transformers, in two groups. At the right is an exciter board of four panels with two pairs of busses adjacent to six more transformers like those on the left; and lastly, a four-panel plug-board to control the 11,000-volt output of these 12 transformers and distribute it as desired to the four feeder lines before mentioned. From either end of the main switchboard the arrangement is as follows:

1. Five generator panels, each carrying one field ammeter, one alternating-current ammeter and one long scale polyphase watt-

meter, two circuit-breakers, nine 1,200-ampere U-blade switches, synchronizing lamp of 5 cp and synchronizing plug.

2. Two feed panels, each controlling three of the 325-kw transformers and equipped with three ammeters connected to three 5-ampere series converters directly in the circuit of each transformer, three circuit-breakers and nine 2,000-ampere U-blade switches.

3. One feed panel similar to the last two, but equipped for 3,000

FIG. 2.—TRANSFORMER HOUSE.

amperes per leg, and controlling three of the 950-kw, 550-50,000-volt transformers. The eighth panel from either end is a junction panel equipped with 4,000-ampere, U-blade switches, for joining the halves of the sets of busses, and on its upper section carrying six polyphase indicating wattmeters, one connected to each feeder circuit.

The nine separate bus-bars are built of ⅛-in. x 3-in. rolled copper; there are a number of strips on each bus, increasing gradually from six at the outer ends of the board to 30 strips opposite the fifth generator panels. Small marble panels in front of the main board, on the I-beam carrying the crane rail, furnish a mounting for field switches and voltmeter plugs, and six polyphase integrating wattmeters connected to the feeder circuit. Directly below the field switches are the corresponding rheostat pedestals connecting to base-plates, and hung below the gallery floor. The rheostat, which is of the cast-grid type, is also mounted below the gallery floor.

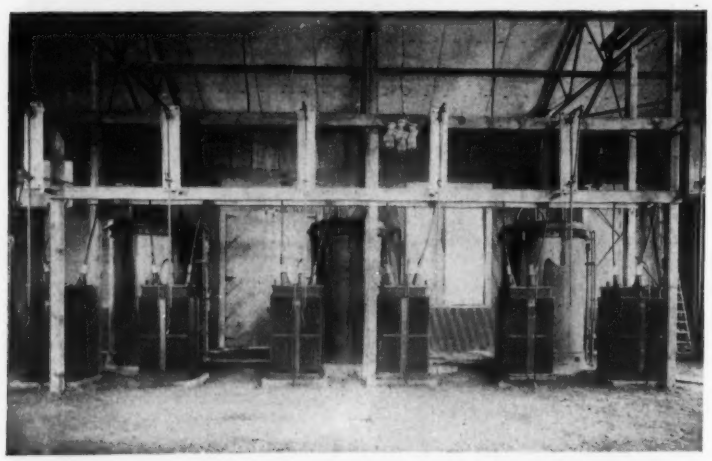


FIG. 3.—TRANSFORMERS.

There are four voltmeters swinging at each end of the board, three for each half set of the three bus-bars, and one throwing-in voltmeter for the five generators on each half. The alternating-current indicating instruments are all long scale, and of exceedingly wide range. All switches are of the latest unit-blade type of very ample capacity, while the current density in busses and cables is nowhere allowed to exceed 500 amperes per square inch. All circuit-breakers are non-automatic, of the air break brush type, of ample capacity, and easy operation.

During the period of change from the old two-phase to the new three-phase switchboard, the two systems were run in parallel on the 11,000-volt side for several days with perfect satisfaction.

From each of the four small feed panels six 1,000,000-cm., lead-covered cables are led through an open cableway level with the top of the switchboard directly to the 325-kw transformers, the circuit-breakers on the board being connected each in one leg at the transformers, as are also the ammeters.

From the high-tension side of the transformers, No. 4°/₂₂ rubber-covered units lead straight to a cross-arm on the roof trusses, thence distributing to the proper wire of 12 busses, which are supported on the roof trusses, and leading down to the 11,000-plug-board at the extreme right. During the various changes necessitated during construction these busses were found very convenient for facilitating the removal of transformers, changing from two-phase to three-phase, etc. From the plug-board current passes through lightning arresters in the addition to the power house, and thence straight up through the nearly flat roof of the addition. The insulation consists here simply of rubber-covered wire drawn through 2-in. x 36-in. glass tubes which are supported by split wooden bushings; the tubes are surmounted by 12-in. conical galvanized taps tapped to a water-tight joint next to the wire. The wooden bushings are flashed to the roof to form a water-tight joint, and are lag-bolted to the roof.

FIG. 4.—THREE-PETTICOATED INSULATOR.

The 550-volt leads are brought out through the roof in an entirely similar manner through glass tubes 2 inches x 40 inches, with light cone of heavy waterproof canvas and dry wooden frame, with a base diameter of 18 inches, used for a protection from moisture.

From each of the two large feed panels eighteen 1,000,000-cm. cables lead through convenient doorways, pass along the wall of the addition, and thence span a distance of about 5 feet to the low-tension terminals of the 950-kw transformer sets. One leg of each transformer can be opened by the circuit-breakers on the main board, the other leg by knife switches, located in the doorways mentioned above.

The high-tension leads of the transformers pass first through static interrupters, then through fused circuit-breakers on one leg and a plain knife switch on the other leg, thence connecting to three bus wires of heavy rubber-covered wire overhead. The outer end of each of these busses connects through fused circuit-breakers through the roof to one of the two three-wire lines to Butte. The inner ends may be tied together by similar fused breakers. Thus either transformer set may feed either line, or both may be fed in parallel or separately. Also, any transformer may be entirely cut out by opening both high-tension and low-tension leads, without interrupting the service.

The static interrupters are comparatively novel. Their theory and commercial form were fully described by Mr. Thomas in a recent paper before the American Institute of Electrical Engineers. They consist essentially of a choke coil in series with the trans-

former lead, and a condenser connected on the transformer side of the choke coil to ground, the whole immersed in oil. The ground current from this condenser has been put to a novel use by the electrician of this company. The Weston alternating-current voltmeter is used as an ammeter connected in the ground circuit of the condenser to determine the condition of the transformers and attached line relative to ground; the induction being fully that of the dynamic current, many bothersome features of the ordinary static inductor are avoided. There are, of course, sources of error, but these do not prove troublesome.

The main transformers are water-cooled, but the coils being about 6 feet above the level of the water in the forebay, it was necessary to have recourse either to pump circulation or to some form of siphon. Main intake pipes in duplicate, supplied with proper strainers, were brought in through the canal wall below low water level. The transformer coils were bridged between there and other pipes leading 30 feet down to the tail races. These intake and discharge pipes were connected by a valve which allows water to flow directly through the discharge pipe vents, thus starting a vacuum. This valve is then closed, and water is immediately siphoned through the transformers. A common vacuum gauge shows the condition as to vacuum, while in the discharge pipe of each transformer a small brass pipe 12 inches long and ⅜ inch small and 1½ inches large diameter has a single mercury U-tube connected between the central small diameter and the upper end of the pipe, affording an accurate indication of the amount of water circulating through the transformer.

Each of the six cables of the two feeder lines to Butte are protected by lightning arresters at Canon Ferry and Butte. These cables are of seven strands of copper aggregating 106,500 cm. each, mounted on special glass insulators designed by H. M. Gerry, Jr., chief engineer and manager of the company, and made by the Hemingray Glass Company, Covington, Ky. The insulator proper is three-petticoated glass 5⅛ inches high and 9 inches diameter, the pin extending as near as possible to the wire groove below the insulator; extending up inside the inner petticoat is a tapered glass sleeve 5½ inches diameter at its lower end, clearing the cross-arm by 1¼ inches, and supported on a 1¼-inch shoulder on the pin. The pins are all seasoned oak, still further dried and impregnated by boiling in hot paraffin, so that the pins themselves stand 100,000 volts on test. The pins are 12 inches long above the butts, 1½ inches at top of thread, which is of standard pitch. The maximum diameter is 2½ inches, tapering on a 60-degree angle at the top of this butt, whose diameter is 2 inches for the pin which fits the cross-arm, and 2⅛ inches for the pin which fits the pole tops. These latter butts are 8 inches long, the former 5½ inches, and a special reamer insures a close fit of the 60-degree taper at the top of the pole and on the cross-arm. The distance between the line cables is 18 inches. The pole lines are 40 feet apart, and the right of way is entirely cleared of trees, etc. The poles are of Idaho cedar, 8-in. tops, and in length from 35 to 90 feet, all poles above 75 feet being spliced.

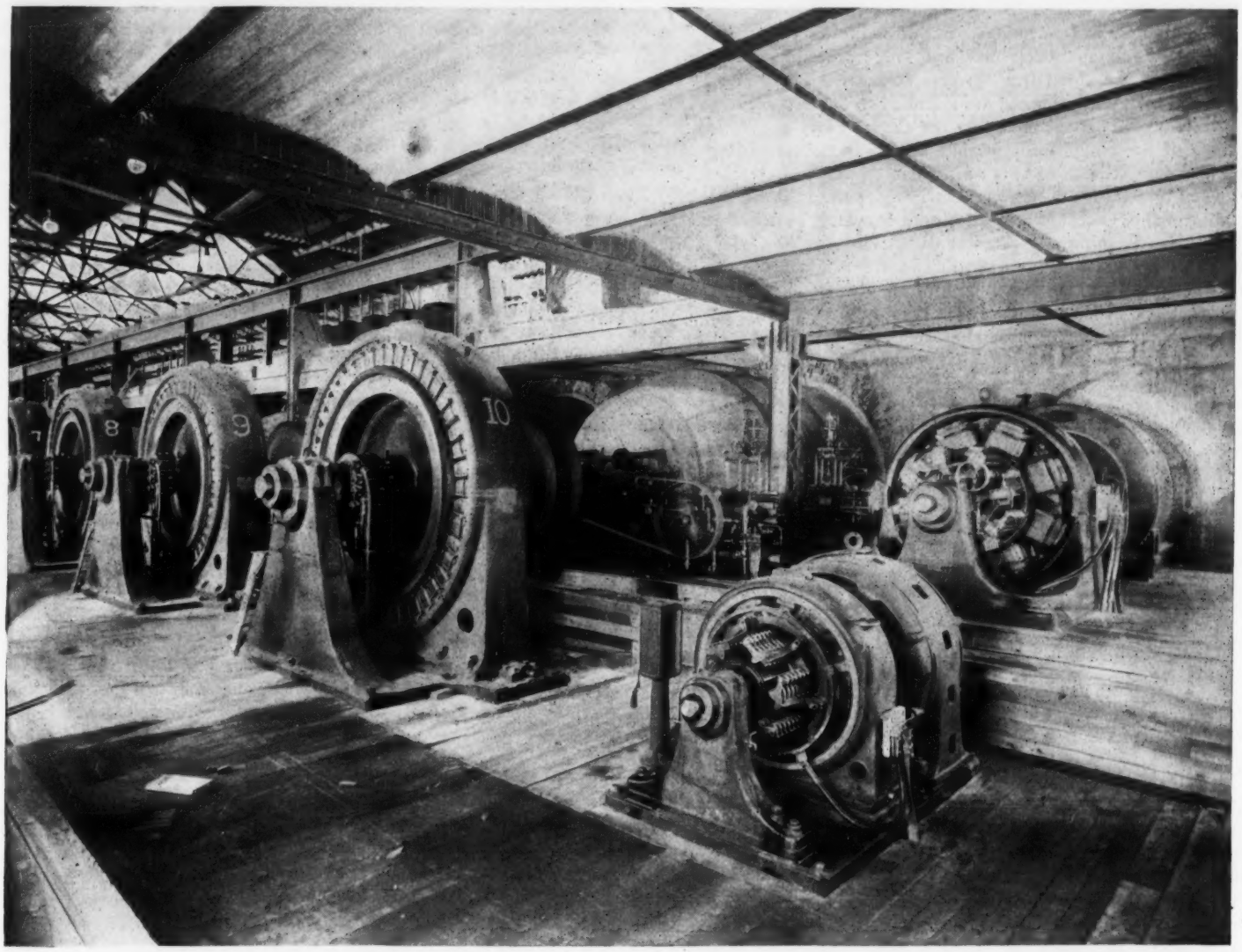


FIG. 5.—VIEW OF INTERIOR OF POWER HOUSE.

The Butte sub-station is a steel and corrugated iron building, 60 ft. x 80 ft. x 20 ft. studs, the feeder lines entering at one end through glass tubes 2 in. x 48 in. passing through a wooden panel and protected from the weather by a shed roof overhanging about 5 feet.

Low equivalent arresters, fused line breakers, paralleling breakers and breakers on each leg of the six 950-kw transformers, together with the static interrupters, are practically a duplicate of the equipment at Canon Ferry. The arresters, line and tie breakers are at the end of the building; the transformers are along each side of the central court, toward which all breakers open. The main switchboard here consists of two 40 in. x 9 ft. 9 in. panels with three circuit-breakers, three ammeters and six knife switches, each connecting the low-tension (2,200 volts) of the transformers to either or both of the two bus sets. As at the generating station, the switch-

board circuit-breakers open one leg of each transformer circuit, while a knife switch mounted on each transformer case opens the other leg. These transformer cases are very substantially built of heavy boiler steel, with cast-iron and walnut covers bolted on, and hold about 16 barrels of transformer oil each. A pair of synchronizing lamps and a swinging voltmeter are provided. Integral with these two panels on either side are panels 20 inches wide, on which are mounted the sets of feeder instruments, three ammeters and one polyphase indicating wattmeter. These feeder circuits feed out through three-pole, double-throw General Electric oil switches to bare stranded cables of 600,000-cm. section, leading to the company's various loads in Butte.

There are at the present time three of these feeders, and the switchboard instruments are provided with an unusually ample range so as to read starting motor currents and even short-circuited currents. All feeder wattmeters take their series currents from three to five-ampere, series-connected coils directly in each transformer circuit, the three currents being combined into two circuits of 8.6 amperes each at full normal speed, through the two coils of the wattmeter. The shunt circuits are fed from auto-converters at Canon Ferry, and shunt transformers at Butte. These meters have a long and uniform scale, and are intended to be very accurate under all conditions. The wattmeters at the Canon Ferry generating plant are also of the polyphase type, but are connected according to the more common scheme of two wattmeters on three-phase circuits.

As before stated, all station electrical apparatus is of the Westinghouse make, except a few oil circuit-breaking switches at Butte. Nearly all consuming apparatus at Butte, however, is General Electric. This apparatus, aside from incandescent lighting to the mines, consists entirely of induction motors ranging from one to 800-hp capacity, there being at the present time only one of the latter size driving an air compressor at the Anaconda mine at constant full load. Most of the motors from 50 to 300-hp capacity are equipped with rope drive. Some of the smaller motors are direct-connected to 500-volt generators, furnishing direct current for cranes, mine trolleys, etc. Power is supplied for a great variety of purposes at the great copper mines and to the smelters and various reduction works at Butte.

Telephonic Growth in Arizona.

The Tombstone (Ariz.) Telephone Company has completed its local system and now has its construction force putting up poles and stringing the wires from that place to Bisbee. It is expected to make a connection with the local system there not later than the middle of August.

The Tombstone company, after reaching Bisbee, will begin the construction of a line north to a connection with the Gila Valley Telephone Company at Solomonville. This connecting line will touch at Pearce, Black Diamond, Cochise, Willcox and Fort Grant. The Globe Telephone Company has now about completed a connection at Fort Thomas with Alexander Bros.' line which will connect with the Gila Valley line. When these connections are made from Tombstone and Globe, every important point in Graham, Gila and Cochise counties will be connected by telephone.

The Globe company will reach Globe, Black Warrior, Rice station, San Carlos and Fort Thomas. The Gila Valley company now reaches Fort Thomas, Matthewsville, Pima, Safferd, Thatcher, Solomonville, Guthrie, Clifton and Morenci. The Tombstone company will reach Solomonville, Fort Grant, Bonita, Willcox, Cochise, Pearce, Black Diamond and perhaps other camps in the Dragoons, Tombstone and Bisbee. From Bisbee south, the Bisbee Improvement Company already has connection at Naco with the Cananea line and at Douglas with the line owned by the Douglas Improvement Company.

These are local systems owned by home people. It is also known that a telephone line is to be built from Douglas to El Paso during the next six months. This line will connect with the Rocky Mountain Bell Company at Deming and with the Southwest Bell Company at El Paso. The Sunset company have sought a connection with the Gila Valley Telephone Company and also with the local system in Bisbee. The Sunset will, of course, connect either at Globe or Tombstone. If it connects at Tombstone, Benson would be brought within the "hello!" circle. The Sunset expects to complete the connection of their Arizona lines with the Los Angeles soon.

By the first of the new year the probability is that Solomonville can speak with every city in the southwest and as far as Chicago and Los Angeles through a telephone. Southern Arizona is fast getting out of the wilderness.

Electric Pumping for Irrigation.

By Aug. J. Bowie, Jr.

THE subject of electric pumping for the purpose of irrigation is one of growing interest in the West. In many parts of the country the rainfall is so small that irrigation is almost wholly relied on for the cultivation of the land. This irrigation has in the past depended largely upon diverting water from the rivers and streams that flow through the land, and distributing the same, by canals and ditches, over the ground to be cultivated. In the West, until comparatively recently, little use had been made of the water other than that which nature had thus provided, above the surface of the ground. These rivers and streams furnish a variable supply of water—at times, when they are high, giving far more water than can be used, and when they are low, falling far short of the desired supply. Extensive plans have been made, chiefly in an embryonic state, for constructing large impounding reservoirs, with the idea of regulating the flow of water, so as to make it more uniform, and to turn to profitable use as much of it as might be possible. Should these results be accomplished, great ultimate benefits will of course accrue from them. Floods will be largely prevented—the water from which they had previously been fed being stored for use at times when the flow of the rivers is small, or even when it disappears altogether.

Underlying the surface of the earth are strata of various materials. Some of these are saturated with water, holding within themselves a volume of water of fully one-third of their entire bulk.

To those who have never studied this subject, the extent of these subterranean reservoirs of water will appear prodigious. Imagine that fully one-third of the volume of the earth, even for a depth of one hundred feet, is composed of water; that this water supply is constantly being replenished from many sources, and it will at once be apparent what an almost inexhaustible reservoir the earth becomes.

This is especially true where this water is pumped for the purposes of irrigation, as by far the greatest part so used returns whence it came, the amount of water which is turned to useful work, in nourishing vegetation or which is lost in evaporation, being only a comparatively small proportion. This is notably the case in sandy soils where the amount of water which filters through the surface is very great. For instance, it is nothing unusual in such soils to use for a single irrigation enough water to cover the entire land to be irrigated two feet deep. This, of course, is a great waste of water, and could and should be much cut down by proportioning properly the size of the checks to the head which is to be used in irrigation.

Perhaps the method of irrigation most commonly used, is to divide the land into checks, throwing up embankments of earth all around them. These checks are laid out on contour lines, the fall in each check, or the difference of elevation, between the top and bottom contour lines varying with the fall in the ground. They are fed from ditches, and water is turned into them until all parts of the land in that check are submerged. Then the enbankment on the lower side is cut, thus letting the water drain down into the next check, and turning as much of it to good use as is possible without allowing it to filter through the soil. The object is simply to wet the entire surface of the ground. However, in the time which it takes the check to fill, much of the water has of necessity filtered through the soil and gone to waste. The use of a large head of water cuts down this loss very materially. Large heads of water require skillful handling in the matter of irrigation. Small checks interfere with agricultural operations, are more costly to make, and require more attention in irrigation. It is a matter of no small importance to proportion somewhere nearly properly the size of the check to the head of water available. The character of the ground should, of course, be taken into account in all such calculations.

Water-bearing strata extend often for many hundred feet below the surface of the earth. The water pressure in different strata—that is when these strata are separated by other strata practically impervious to the flow of water—will often be different; the water standing at different levels in the well, in such cases, as the well-casing goes down. When the water level of a stratum of water-bearing sand or gravel is higher than the surface of the ground, the well becomes a flowing well, or artesian well as is commonly said.

The word artesian is often misapplied to wells which do not flow. Artesian wells will discharge a quantity of water of such magnitude that the loss of head by friction in the pipe and in the strata leading to the pipe is equal to the height above the outlet to which the water would normally rise in the casing at no discharge. The flow of

water from an artesian well is no way different from the flow of water from a pumped well, both following the same laws. The water-strata which supply artesian flow get their pressure usually from some distant sources at higher elevations. These strata are not at all replenished by the water which the wells discharge; such water when used for irrigation going into the strata much higher up. As the water which supplies these artesian wells gets its pressure from so far away, and as the strata may be limited in extent, sinking several of these wells, even though they may be miles apart, may in time interfere seriously with the flow from each other. For the reasons given above, these will be far more subject to mutual interference than in the case when the strata are near the surface, where the water for irrigation is constantly replenishing them.

The flow of water through porous media, according to numerous experiments made, is directly proportional to the head causing such flow. The writer performed such experiments on one pumping station which had been in operation for some time, which agreed very closely with this theory. They showed that the flow of water from wells was directly proportional to the distance which the ground water was lowered. It is probable that this is true in most cases, though, owing to the peculiar conformation of the ground, this will not always be so.

In many localities in California the level of the surface of the ground water is from five to thirty feet below the surface of the ground, and it is not necessary to sink wells further than to a depth of eighty to one hundred feet before getting an ample supply of water-bearing strata from which to draw for pumping.

There are two different cases under which pumping plants may be installed. The first case being where the installation is intended to supplement the water supply from the rivers in event of any shortage or failure of the same, and the second case being where the supply from the wells is relied wholly upon to irrigate the land.

In considering the first case, whether the system can be reckoned as a financial success is largely a matter of chance. It is all a gamble. In fact, it bears a close resemblance to spending money for fire insurance policies. If no fire occurs, the money so spent is of no benefit. So it is with these plants—if there is plenty of water in the rivers the plants will, of course, be financially a failure. They are depreciating all the time whether they are worked or not. If the plants are worked for only a month in the year, they may save a crop by so doing. The water they pump will, of course, cost very high, as the fixed expenses will be especially large. It is almost impossible to estimate the value of such a plant, even at the end of the year, and it resolves itself into simply a matter of insurance.

As a general proposition, the water pumped from pumping plants will furnish a much smaller head than that which is used for irrigation from the rivers. Ditches for carrying river water will be so large that the small amount of water pumped will suffer great losses from seepage while flowing through them. Also, the checks will be so large that most of the water will be wasted in flooding them.

One way out of part of this difficulty is to construct a reservoir of moderate capacity near the pump station, and to pump the water into it. The ground should be thoroughly puddled to reduce the seepage as much as possible. Should the reservoir be too large, the loss by seepage and evaporation may fully equal the water pumped into it.

This shows some of the difficulties of endeavoring to supply large ditches and checks from pumping stations, and shows some of the radical errors which can be made in not proportioning properly the amount of water to be delivered to the work to be done. Much attention is often paid to getting a few per cent higher efficiency from motors and pumps; while far too little attention is paid to the subsequent use of the water pumped.

Where pumping water is so comparatively expensive, it will surely pay to devote much attention to its proper distribution. It often will pay to put in additional small ditches rather than to try to run water in ditches out of proportion. For instance, the writer recalls one case where two pumps discharged into a twenty-foot ditch, a half-mile long, a flow of about seven cubic feet a second, and were just able to hold the water up about three feet deep, with no discharge. The ditch ran through a very sandy country, consequently the seepage was very large.

In the second case to be considered where pumps are to be depended on for irrigation, the problems to be solved are of a more definite nature. Ditches, checks and pumps should be proportioned for a proper flow of water.

Where the land allows it is often a good plan to have two or more stations so located that they can be used either separately or the combined flow can be used in irrigating the land. It is, of course, important to have the distance which the water has to flow in the ditches as short as possible, and the pump stations should be located with that in view. It may often pay to have the ditches lined with cement, to minimize the loss by seepage; as considerable expense may be justified in this connection. Usually one well will be insufficient to supply the demands of a station for irrigation, in which event additional wells are put down. These, of course, interfere with each other to a certain extent.

The level of the ground water varies with the seasons, with the rainfall and with the amount of irrigation; a succession of dry years lowering it decidedly, and wet years correspondingly bringing it up. It is advisable to get some idea of the extent of this variation before starting in to install pumping plants. Continued pumping from stations will in general lower the level of the ground water at these stations, though after the pumping plant has been shut down, the water will rise in the ground continuously for some time.

Having ascertained the condition under which the water is to be delivered, the amount desired and the level of the ground water, then the next step is to determine on the system of pumping which is to be employed.

Pumps for this purpose may be classified under three different heads. 1. Deep-well pumps. 2. Those not for deep wells, where the pumps are placed where all parts are readily accessible. 3. The air lift.

Where the water is within a reasonable distance from the surface, it will usually pay to use the second class, especially where a large quantity of water is desired, although it may be necessary to sink a pit to get the pumps nearer the water level so as to increase the available flow from the wells.

Deep-well pumps as a class are not advisable for handling large quantities of water. They are necessarily limited by the size of the wells, and the fact of having their working parts far from the surface is also a disadvantage.

Their field is especially adapted to handling limited quantities of water, where the distance from the ground to the surface of the water is fairly great. A very fair efficiency can, under these circumstances, be attained.

The long lengths of connecting rods in lift pumps necessitate slow speed for suitable operation. The jar of starting the column of water on the up-stroke is intensified by any lost motion in these connecting rods, and as a result the machinery must be very rigid and must run slowly.

The air lift may be advantageously used in many places, where several wells located near a central source of power are to be pumped. This possesses the advantage of extreme simplicity, and of having all parts which it is essential to handle conveniently located. It has the disadvantage of comparatively low efficiency, and of the attention which it is necessary to give the air compressor.

As a general proposition, where irrigation by pumps is carried on on an extensive scale, it will be done by the second class of pumps. This case being of most interest, will be the only one which will be further discussed.

The system of pumping which it is advisable to install depends largely on the form of power available. In case comparatively cheap fuel is available, as is at present the case in many parts of California, it might pay to install a central air station with engines and compressors, and to pump the wells by the use of air lifts; that is, provided it was not too far from this station to the wells. However, electric lines are at present in operation and being constructed over many parts of California. Cheap power is at many places available for the operation of motors, furnishing a simple and reliable means of obtaining energy. It was mainly with an idea of expounding the use of electric power in pumping that this article was written. It has been necessary to digress from this subject, however, to show the proper application of results of this pumping in order to present a clear view of what was to be accomplished, and what obstacles are in the way.

The pumps most commonly used would be either direct-acting power pumps or centrifugal pumps. The former will give better efficiency in general; but it is necessary to reduce the high speed of the motor by double reduction belting or gearing in order to obtain suitable speed for the pumps. This is in itself an objectionable feature, in addition to the power loss which it entails. Also,

there are many wearing parts and bearings about these pumps, all of which require attention and oiling.

With centrifugal pumps, on the other hand, the wearing parts and bearings are reduced to a minimum, and consequently the attention they require is very small. There is little to get out of order about them, and while in general they may not be quite as efficient, still they are far preferable for the general purposes for which irrigation pumps are used. Having decided to install centrifugal pumps, the next question is as to the method of connection of the same to the motor.

In general, as will be explained later, it is advisable to put the pump down as low as possible in the ground. The motor, on the other hand, must be where it will be out of danger of becoming wet. Pump pits may be flooded or the ground water may rise very high. While the pump is in operation there will be in general no danger of the pit being filled; but when the pump is shut down the water may rise above the pulley of the same. Under these conditions, if the pump is belted to the motor, this will necessitate bailing out the pit before the motor can be started, and if the belt had not been taken off, it may be ruined.

No end of trouble has been caused by belted plants installed in dry seasons, having the ground water rise above the pump pulleys. In some instances it has been necessary to pump the pits for hours with other pumps, before lowering the water sufficiently to put on the pump belt, and even then should the pump stop even for a short time, the pit will immediately fill up with water.

Direct-connected units in large sizes are generally preferable to belting. Where the wells are of ample capacity, horizontal units will be preferable, these being located near enough to the surface to avoid all danger of the water rising up to them. Horizontal units are simpler than vertical units, and on this account should be used where they are possible.

Where, however, it is a question of obtaining all the water possible from the wells, which is usually the case in irrigation problems, the pumps should be set as low down as possible. One reason for this is to be able to pump the wells as far down as possible without exceeding the suction limit, and hence obtain more water from them. Another reason which is important is that all well water contains more or less entrained air. This air expands very much in the suction pipe with increased vacuum, and may cut down very materially the discharge from the pumps. Should the pump exhaust the water too far in the wells, this air is liable to make it loose its priming and in consequence the pump will stop pumping.

Where the pump is placed very low down where it may be under water, vertical units must be used if they are to be direct-connected. The pump could, of course, be belted to the motor by a quarter turn belt, but direct connection is preferable. A simple vertical frame of angle iron can be used for the motor and pump. This frame can be steadied by bolts, connecting it to the timbers in the pit. It is not always necessary to have the motor above the surface of the ground, and in this event these frames can be very much shortened, to their advantage.

It makes no difference whether or not the pumps are submerged by the rising ground water. The only difficulty is in event of its being necessary to take out a pump or to make repairs on it in place. In this event it may be necessary to pump out the pit by an auxiliary pump.

It is well to have such an auxiliary pump on hand. A very convenient method is to have a direct-connected pump and motor mounted on a wagon with electrical cables, and rubber suction hose. In event of being unable to afford such auxiliary apparatus, it will be well not to try to put the pumps down too deep, so as to be inaccessible from rise of the ground water.

Direct-connected vertical units as commonly installed figure on supporting the weight of the rotor and of the runner almost entirely by the up thrust of the runner. Of course, the ideal method of running is where there is no weight to be supported by the bearings, all thrust being taken up by the difference of pressures on the two sides of the runner. With this object in view the suction side of the pump is usually on top.

Great difficulty is often experienced from the unbalancing of pumps, creating very large end thrusts and damaging the bearings. A centrifugal pump runner has a natural tendency to unbalance itself, and the further it goes to one side, provided there is end play, the stronger will it pull in the direction in which it goes. The extent and the possibility of this pull can be imagined, when supposing the runner to be twenty inches in diameter, a difference of pressure of one pound per square inch between the two sides will produce three hundred pounds difference of end thrust.

The proper balancing of pumps is a very important item in their successful operation. Ignorance in this respect may lead to very bad results, enormous end thrusts being brought into play. Proper adjustment of the runner is of prime importance. Difference of discharge as the ground water is gradually lowered in the wells will cause a variation in the end thrust, and while the pump may balance while the ground water is at a certain level, still, when it has been lowered a few feet, it will be out of balance.

Of course small differences of end thrust are easily taken care of in the bearings, but the usual form of bearings used in the West for that purpose is insufficient for taking any great end thrust. Some of them are incapable of taking even the weights of the rotors and runners wthout overheating.

Some automatic balances have been put on pumps of this nature which have been entirely ineffective. The writer got up a form of automatic balance for pumps which worked very successfully and kept the runner off either end bearing. One-half inch end play was allowed in the bearings, the runner working up and down only about one-sixteenth of an inch, running clear of either bearing when the balance was in operation.

Vertical bearings for the motors and the oiling devices for the same require considerable thought to give satisfactory results. They are more complicated, decidedly, than horizontal bearings. The lower motor bearing is often made almost inaccessible, so that it is impossible to tell what is going on, and one has to put his faith in providence till the bearing burns out. Of course this should not be allowed.

In connection with this subject are suggested the conditions under which these motors have to operate. Where there are many pump stations operated by the same company, scattered over considerable territory, it becomes a matter of importance to reduce as far as possible the expenses of operation.

It is cheaper, far, to have an occasional bearing burnt out than to keep men in constant attendance at each station. Two visits a day of twenty-four hours to each station has been found to be sufficiently satisfactory in the operation of such stations.

In a sandy country, sand storms will force considerable dirt and grit into the buildings, especially where they are not substantially put up. This is liable to find its way into the bearings and to cause trouble, particularly where there is no one in attendance. The bearings on this account should be made as dust-proof as possible.

For the vertical bearings of the motor, the oil is usually kept in circulation by being thrown up by centrifugal force from an oil-cup on the shaft into the top of the bearings. Where this is done, it is well to provide a filter for the oil before returning it to the bearing.

Many bad forms of oiling devices for vertical motors are made. A fine spray is formed where the stationary tube goes into the rotating oil-cup, which in short order throws all the oil out of the cup and all over the motor. By suitable design this can be prevented without difficulty.

Proper ventilation of the buildings having motors and transformers is a thing which should not be overlooked. Places where irrigation pumping stations are located are usually places where the temperature goes up very high in the summer time, temperatures as high as one hundred and twenty degrees in the shade not being uncommon. This is, of course, a higher temperature than is usually figured on for electrical apparatus, and in consequence it is well not to overload the same. High temperature will, of course, cause rapid deterioration of the insulation. Some means of cooling the air in the motor and transformer rooms is desirable.

A very important item in the expense of operating stations in the country is that of team hire. It cuts a very large figure in the costs of repairs of apparatus where the same has to be hauled any distance. So it usually is a good plan to do as much of the repair work as possible in place. By watching carefully, so as to minimize the hauling, considerable money can be saved.

Where there are no attendants constantly at a station, automatic cut-outs should be provided, so that should the power go off or the pump lose its priming, the motor will be automatically switched out. These cut-outs should be governed by the flow of the water, and should not be electrically controlled or governed by the stopping of the pump. One reason for this is that should the pump lose its priming, these other devices will not cut out the motor. Another

reason is that these devices are the simplest, the cheapest and the most reliable.

Where the vertical thrust bearings are on the motor, many motors rely on the water relieving the bearing of part of the weight of the rotor; and when the rotor and the runner are running with no water in the shell, these bearings will get excessively hot. So with this type of bearing it is essential that the motor be cut out when the pump stops pumping.

Some manufacturers use marine type bearing on the pumps, these bearings taking all the end thrust of the pump, as well as the weight of the rotor. It is, of course, advantageous to balance somewhere nearly the end thrust of the pump so as to avoid as much friction and wear as possible.

The simplest form of cut-out for the motors is a float cut-out Where the water discharges over a weir, the head of the weir as well as the friction head in the discharge pipe can be made use of in operating these cut-outs.

Another plan which the writer has used, where the water was delivered through pipes at a distance from the station, was to put a vane in the pipe itself, with bearings on each side. A rod came through one bearing and a stuffing box. This rod was weighted by a weight on a bell-crank lever, tending to keep the vane closed. The vane was so bent that when wide open it conformed closely to part of the perimeter of the pipe, thus reducing to a minimum the friction in the pipe. The bell-crank lever communicated through other levers to tripping the device for opening the switches. All such devices should be as compact and as direct-acting as possible.

In regard to the proper selection of a location for a pump station, the location is usually selected with reference to convenience in pumping the water and distributing it.

There is no more uncertain matter than the manner in which a well is going to turn out. One well may be sunk within fifty feet of another, and while the first may give a splendid flow, the second, even if sunk to just the same depth, may furnish almost no water at all. When the depth of the well is moderate, say fifty to one hundred feet, it is usually a good plan to sink a small test well first, to determine the nature of the soil. If this well shows a sufficient amount of good water, sand or gravel, then a well of the size desired should be put down. However, it is by no means safe to go on indications alone, and this well should be tested by pumping it. This can be easily done by the use of a centrifugal pump driven by a portable engine.

Having found a well to give sufficient flow, any desired number of wells may be put down, but it should be borne in mind that the flow obtainable will not increase as fast as in proportion to the number of wells put down, as, of course, the wells will interfere with each other.

The simplest form in which to put down the wells is in a straight line. This involves least amount of construction and pipe. The best form, perhaps, is in the shape of a cross, the wells going out in four directions from the pump. This will give greatest distances between wells, hence interfering less with each other.

Of course the greater the discharge from the wells, the further down will the water be pulled in them, and the greater will be the lift. In addition to this, greater continued discharge will cause still further lowering of the ground water, necessitating additional lift, and hence additional power. Call A the distance from ground to ground-water, B the distance ground-water is pulled down, Q the corresponding discharge, and P the power required for that discharge, then

$$P_1 = KQ\ (A + B).$$

If it is desired to double this discharge, and this can be done without exceeding the suction limit, then

$$P_2 = 2KQ\ (A + 2B).$$

If $A = O$, additional discharge is obtained only by increasing the power as the square of the desired discharge. As A is not in general zero, this power will not increase as fast as in proportion to the square of the discharge, but will increase decidedly faster than the first power.

Bearing this in view, it would seem to be better policy to put in more wells to pump from (provided these be not too expensive) rather than to put the pump too far down, and to try to exhaust the wells too deep. The cost of power and the cost of the wells should all be taken into account in those calculations.

An important item from the practical standpoint is to have the suction pipe as short and as simple as possible. A very small leak in the suction, which may not be of sufficient size to make the pump lose its priming, will still cut down the discharge decidedly. Where the entrained air is considerable, means should be taken to cut it off.

If perforations in the well are above the level of the water in the same, the water pouring down through these perforations will drag air down with it. If this is of any extent, simple means may be provided to prevent the splash caused by the dropping water.

In general, it must be remembered that exact conditions cannot be figured on, that the head will vary in some instances to a considerable extent, and that the efficiency of the pumps will not be what we should like to have it. It is inadvisable in any extended system to have several makes and sizes of pumps, and it is well if possible to have them all alike. The same thing applies to the motors. Too many different kinds of pumps and motors make a needless amount of work. It may often be well to sacrifice efficiency to simplicity.

Too many mistakes are made in plants by the assumption that they will always run under the maximum efficiency, delivering the rated amounts of power or water, or whatever it is.

If it be an irrigation plant, the water is assumed to be distributed over the land, with no appreciable loss. Interest on the investment and depreciation are not taken into account. When the actual cost of irrigation is figured, it is found to be far different from the original figures, which included only the cost of power and operating expenses, the theoretical highest efficiency, continued running of the plants and the distribution of the water with no appreciable loss. It is similar to figuring the output of an alternating station, at 100 per cent. power factor and 100 per cent. load factor, no accidents being allowed to occur. Of course, these would be ideal conditions of operation, but would almost never be attained.

Before leaving this subject, it will be well to point out a very important phase of the problem, namely, the advantages to be derived by electric companies from a load of irrigation pumps.

Such a load by proper manipulation can be made to fill in many of the inequalities of the load curves of these stations, and the power so furnished, in the case of water-power plants, can be supplied at no additional cost. It is power which would otherwise go to waste. By arranging with the consumers to have the motors cut out during the peak load, this power could be furnished at a price sufficiently reasonable to make it quite an object to the latter, and all the money so obtained is pure gain.

Where pumps must be run nearly continuously all year, hardly any sort of load can be considered more advantageous, for many reasons. For example, no serious loss or damage, outside of the sale of power, will be occasioned by temporary shut-downs for short periods. Moreover, the load is not fluctuating, but is very steady. A pumping load will help very much to steady the voltage, not only for the reason just given, but also because any drop in speed of the generator will correspondingly relieve the pump motors of a load which varies as a power of the velocity between the second and the third. Thus, for small variations in speed, the percentage change in the power consumed in pumping will vary from two to three times as fast as the percentage change in speed. This of itself tends very much to steady the speed and likewise the voltage. Another good point of such a load is that the motors are approximately fully loaded, and consequently the power factor is fairly high.

While a certain extent of pump load is very desirable for filling up the load curve, and while irrigation pumps which run practically all the year are also desirable, pumps which would exceed the limit of inequalities in the load curve and which would run only a few months in the year, would be decidedly undesirable, provided that further market could be had for the power.

Taking all these things into consideration, perhaps the fairest charge for pumps is on a flat rate by the year. Two kinds of rates could be furnished—one for those who would be willing to cut out during the peak, and the other for continuous operation.

The writer has endeavored to point out some of the principal points in the installation and operation of irrigation pumping plants, with particular attention to electrically-driven centrifugal pumps, and to show wherein the difficulties lay, and why expected results have not been attained.

The efficiency of the mechanical and electrical part of the plant is given in general a great deal of attention, but the losses which may occur in the distribution of the water are often disregarded. These are really of prime importance, and when an irrigation plant is laid out, particular care should be taken to proportion somewhere nearly the money to be invested to the proper place to make the saving.

The Economic Design and Management of Telephone Exchanges—XIII.

By Arthur V. Abbott, C. E.

KNOWING the number of trunk lines, the only missing factor necessary to determine the trunk lineage is the length of the trunks. It is impossible to predict the exact length and location of trunk lines in any exchange, until the specific territory shall be examined, districted, and the telephonic centers located. But it is feasible to ascertain for any group, another quantity that is proportional to the trunk lineage needed with offices of varying areas, and which may be substituted for the true trunk lineage, passing under the same name, till such time as the telephone centers *are finally* located and the precise trunk lineage can be ascertained, and which will serve as a guide to determine the relative relations of sub-station lineage and trunk lineage when the territory is split up into varying numbers of offices.

It will be remembered that the average length of the sub-station lines is determined by dividing the sum of all the sub-stations mileage in any district by the total number of sub-stations, and that a series of curves was given showing the probable relation between the length of sub-station lines, and the number of subscribers tributary to offices of various sizes, in large and small cities. Now if any office is to deliver messages to sub-stations that lie outside its boundaries the average distance that such messages travel will evidently be the sum of the distances, measured along streets, from the office to all sub-stations outside of the boundaries, divided by the number of stations. The larger the territory embraced by the office under consideration the greater will be the distance from its telephonic center to sub-stations lying outside its boundary and the smaller will be the number of these foreign sub-stations. Hence the average distance, that messages must thus travel, will increase with the size of the offices. This quantity is called the *average trunking distance.* The average sub-station mileage was ascertained by plotting the stations on a map and scaling from the various telephonic centers to which they were tributary. In the same manner the average trunking distance may be ascertained, by scaling on the map from the various telephonic centers to all stations outside the boundaries of the office. It is easy to see that while the average trunking distance is not the same as the trunk lineage, or rectangular distance between telephonic centers, it is proportional thereto. Now if the trunkage for subscribers, obtained by dividing the office trunkage by the number of sub-stations, be multiplied by the average trunking distance a quantity that represents the trunk lineage per subscriber is obtained. If this calculation be made for several offices of various size, it is easy to plot a curve of the results and compare the subscribers trunk lineage in offices of various sizes, and determine which gives the best results.

In Figs. 28, 29, 30, 31 and 32 all of the preceding quantities have been calculated and plotted for five typical cases, namely, Fig. 28, contains the data applicable to offices located in the center of a large city, say, of 500,000 inhabitants; Fig. 29 the same curves for an office located in the outskirts of the same city. Figs. 30 and 31 apply to offices located respectively in the center and outskirts of a medium-sized city of about 200,000 population, while Fig. 23 is for the center of a small city or large town of, say, 75,000 to 100,000 people. All five of the illustrations are plotted to the same scale, and arranged in the same manner, so that comparison is easy. There are nine curves on each sheet, as follows:

Curve No. 1—Number of originating messages.

Curve No. 2—Theoretical Percentage of messages trunked $= \frac{S - S'}{S}$

Curve No. 3—Actual percentage of messages trunked $= \frac{q\,(S - S')}{S}$

Curve No. 4—Out Trunk Traffic = Curve 1 × Curve 3.

Curve No. 5—Out Trunk Traffic per station $= \frac{Curve\ 4}{S}$.

Curve No. 6—Office Trunkage $= \frac{Curve\ 4}{Q}$ + reserve trunks and call circuits.

Curve No. 7—Sub-station Trunkage $\frac{Curve\ 6}{S}$.

Curve No. 8—Trunkage Distance, ascertained from map measurement.

Curve No. 9—Sub-station Trunk lineage = Curve 7 × Curve 8.

On the bottom of each sheet the axis of X is the independent variable and gives the size or number of stations in the office under consideration. The vertical scale on the right hand indicates the number of messages, and is used with Curves 1 and 4, thus in Fig. 28 relating to the center of a large city, the total number of stations in the whole exchange is taken at $S = 40{,}000$, the average originating messages T and $T' = 20$, Q is assumed to be 150, and to vary, say, from .65 to .85, depending on the size of the office. Then in an office of, say, 4000 stations the number of originating calls would be found by following a vertical line from 4000 on the lower horizontal scale till it intersects Curve 1, and then a horizontal to the right finding 80,000 on the scale of "Number of Messages." Similarly the out trunk-traffic for the office is obtained in the same manner by following a vertical from 4000 to the intersection with Curve 4, thence a horizontal to the message scale finding 52,000. On the left hand of each sheet there are two scales of equal parts, the outer one reading from 0 to 500 and the inner from 0 to 20. The inner scale applies to Curves 2, 3, 5, and 8. Thus on Fig. 28 if it be desired to ascertain the theoretical percentage of messages trunked from an office of 2000 stations follow a vertical from 2000 on the lower scale till Curve 2 is intersected, thence a horizontal to the inner scale on the left hand reading 95 per cent. The actual per cent of trunking is found on the same scale by stopping at Curve 3, and reading 87 per cent, while the out trunk traffic per station is found by continuing till Curve 5 is intersected and then reading 15.4 messages on the same inner left hand scale. Curve 8 exhibits the data pertaining to the average trunking distance, as determined by map measurements. Taking the various areas needed to include 1000, 2000 and 3000 stations, etc., scale measurements were made to all sub-stations beyond these boundaries, and the sum of the distances (via streets) thus obtained divided by the number of stations, this fixing the average trunking distance. In an office of 3000 stations the average trunking distance would be found by following a vertical from 3000 to the intersection with Curve 8 and thence a horizontal to the inner left hand scale finding 1.4 miles. The outer left hand scale is devoted to Curves 6, 7 and 9. For Curve 6 (the total trunkage) this scale reads directly in whole numbers; thus, to ascertain the total trunkage (including call circuits) that is needed from an office of 2000 stations follow a vertical line from 2000 on the lower scale to the intersection with Curve 6, thence a horizontal to the outer left hand scale finding 300. For Curves 7 and 9 a decimal point must be prefixed to all the numbers of this scale. Thus the sub-station trunkage and sub-station trunk lineage for an office of 3000 stations is found by following a vertical from 3000 to Curves 7 and 9, and thence horizontals to the outer left hand scale to be respectively .1225 of a trunk line, per station, and, .2025 miles per station. The curves of Fig. 29 are plotted on the assumption that the office is in the outskirts of the same city, and therefore works *into* an exchange of 40,000 station with an average originating message rate of 20. The originating message rate for the office is set at 10; the values of Q, q and other factors are the same as for Fig. 28, while the average trunking distance is compiled from map measurements. Figs. 30 and 31 deal with a medium-sized city. Fig. 30 predicating the exchange in the center, and Fig. 31 on the outside. The entire exchange is taken at 20,000 stations, the average originating message rate for the whole at 16, with office rates of 16 for Fig. 30 and 8 for Fig. 31. The value of Q is taken from 100 to 150 for Fig. 30 and from 80 to 130 for Fig. 31, while q is allowed to vary from 65 per cent to 85 per cent. In Fig. 32 the whole exchange is estimated at 10,000, the originating message rate at 10, Q from 80 to 130 and q from 65 to 85 per cent. As in Fig. 28 the average trunking distance is in all cases ascertained from map measurements.

The preceding data convey general average information appertaining to outgoing trunk business, but it must not be forgotten that the curves apply to trunking in one direction only, and that the quantities must be doubled, on the average, if both incoming and outgoing business is to be cared for. Further, the curve quantities are *linear* measurements, or *circuit* mileage, and must again be doubled if wire mileage is desired. To accurately and completely design an interlacing Reverse Call Circuit Trunking System, and to determine that point at which the increasing trunk mileage overbalances the decreasing sub-station mileage requires that the territory to be served be districted into a number of different offices, the telephonic centers located with some considerable care, and the trunk line routes set-

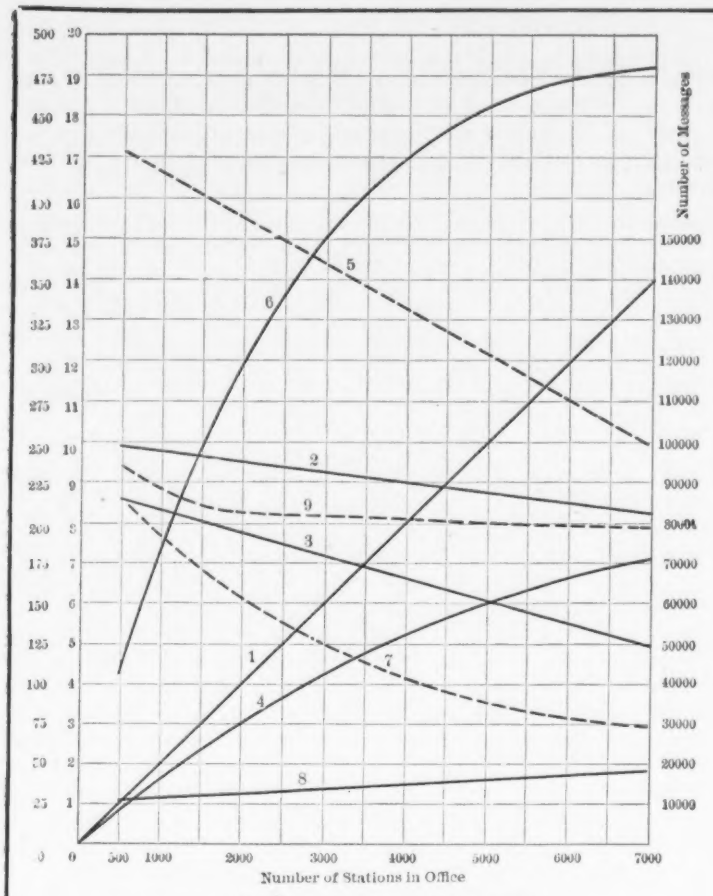


FIG. 28.—CENTER OF LARGE CITY.

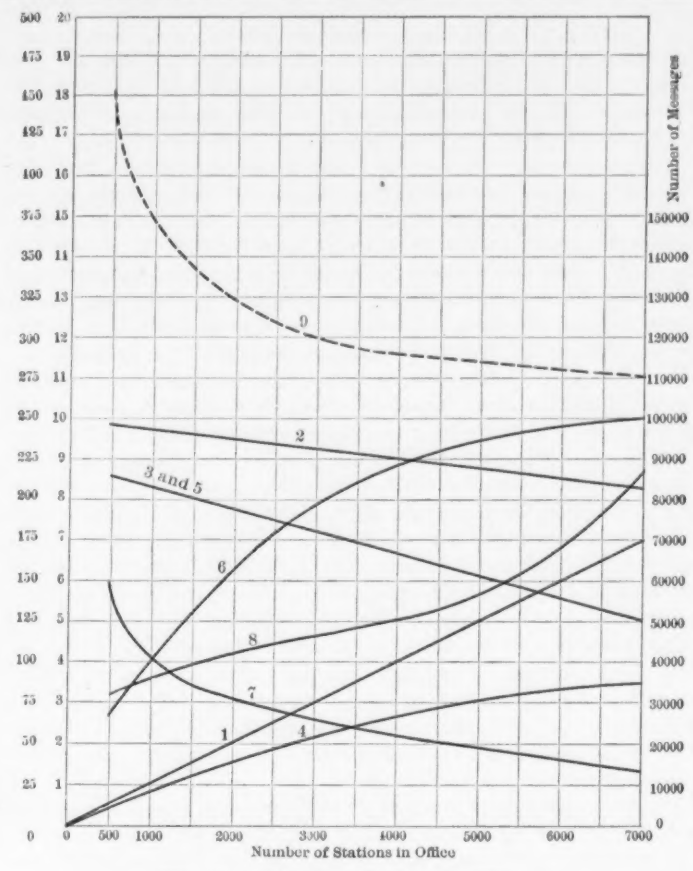


FIG. 29.—OUTSKIRTS OF LARGE CITY.

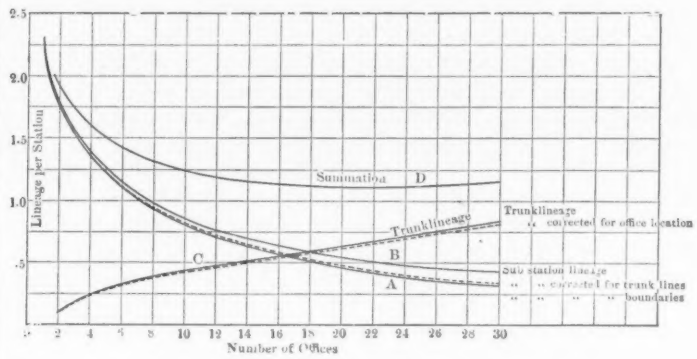


FIG. 33.—LINEAGE PER STATION.

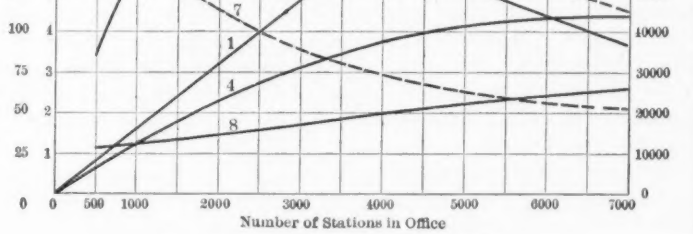


FIG. 30.—CENTER OF MEDIUM CITY.

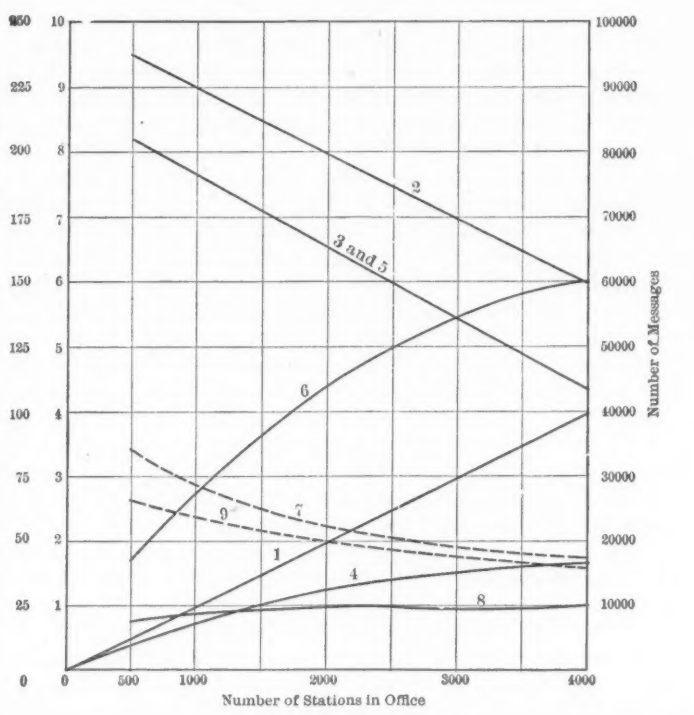


FIG. 32.—SMALL CITY.

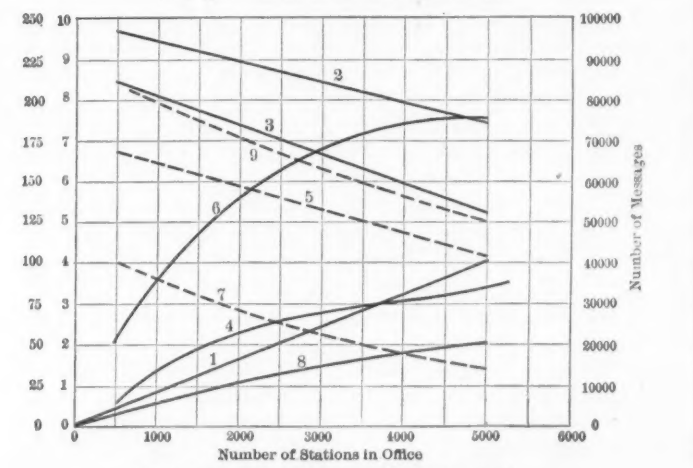


FIG. 31.—OUTSKIRTS OF MEDIUM CITY.

CURVES FOR DETERMINING AVERAGE TRUNK LINEAGE.

tled and measured with a fair degree of accuracy, and then the sub-station and trunk mileage plotted for each of the different number of offices. In Fig. 27 a curve was given showing for an imaginary though typical large exchange, the rate of variation of the average sub-station lineage with the variation in the number of offices into which the territory was divided. If the total trunk lineage be divided by the sum of all the sub-stations the exact sub-station trunk lineage is obtained, and if this is done for each of the different number of offices into which the territory is sub-divided, data for plotting a curve that shows the rate of variation of trunk lineage with a change in the number of offices is obtained. In Fig. 33 curve *C* is plotted showing the change in trunk lineage per sub-station for the same conditions that were used in plotting the curves for sub-station lineage in Fig. 27, which are here repeated. Now by plotting a curve whose ordinates are the sum of the sub-station lineage plus the sub-station trunk lineage, while the abcissæ are the different number of offices into which the territory is divided the total variation of wire mileage with a change in the number of offices is obtained, and by inspection it is easy to discover the least ordinate to this curve and to determine that number of offices which will require the minimum wire plant. In the illustration about seventeen offices show the least ordinate, amounting to 1.2 miles, made up of .60 miles for the sub-station line and .60 miles for the trunk line mileage. Incidentally it is obvious from the discussion of this subject that the curve for sub-station mileage and trunk line mileage per sub-station will intersect at the point of maximum economy in wire mileage, and that this point, like many other similar problems, is reached when the sub-station mileage and trunk mileage per sub-station are equal.

The trunk lines form a series of wires extending from every office in each group to all other offices, and evidently there will be trunk lines extending in all directions rectangularly to each adjacent office. In all but very exceptional cases the number of lines on the different sides of each office will be unequal. Thus offices located on the outskirts of a group will have lines on three sides only, and frequently only on one side. Offices between the circumference and the center will have more lines extending towards the center and less towards the outskirts. So the addition of the trunk lines increases the number if wires radiating from each telephonic center. It has previously been shown that the telephonic center is so located as to place an equal number of sub-stations on each side of each co-ordinate axis drawn through it. This is equivalent to saying that there are an equal number of wires entering from the office on all four sides. The addition of the trunk lines will usually cause an unbalance in the number of wires on one or more sides. If now the office be moved in the direction of the preponderance of the number of trunk lines it is evident that all the lines both of the sub-stations and of the trunks will be shortened in the direction that the office moves and lengthened in the other. By the principles previously enunciated the number of sub-station lines are equal on each side of the office, and until some sub-stations are crossed this equality is uneffected by moving the office. When trunk lines are added therefore the office *should move* in the direction of the preponderance of trunk lines till such a point is reached (by crossing sub-stations) as to cause an equal number of lines to enter on both sides of each co-ordinate axis. So after the number of trunk lines have been calculated and the routes between the various offices selected, inspection will determine whether the location of the various telephonic centers will be sensibly affected. This is easily done on the map of the territory, the various offices being slightly shifted until an equal number of wires enter each, on each side of each co-ordinate axis. By this shifting the sub-station mileage is somewhat increased, while the trunk mileage is decreased but the sum of the two is the true minimum. In the center of large towns or cities this displacement is almost inappreciable, but on the outskirts it may become a source of considerable error unless taken into consideration. Any change in the office location will, of course, react on the curve for sub-station mileage, which must be correspondingly corrected as shown by the dotted line near the curve *A* (Fig. 33.)

All these corrections are shown by the dotted lines in close proximity to the curves *B* and *C*, while the summation curve *D* is plotted for the corrected values. It will be noticed that this curve is quite flat near its least ordinate, there being only a difference of .025 of a mile per station between fourteen, eighteen or twenty-two offices. So that quite a liberal latitude may be exercised in the selection of the desired number of offices without seriously changing the total required wire mileage.

The complete analysis of the relations of office location and the relation of the number of offices to the wire plant has now been exhibited, and the methods of ascertaining the change in wire mileage with any variation either in location or number of offices in any exchange. To determine relative economy it is now necessary to investigate the methods of construction and determine the cost of wire plant.

British Street Railways.

At the recent meeting of the Association of Municipal Tramway Managers, of Great Britain, it was brought out that the municipalities in Great Britain now own and operate about 1,200 miles of tramway track, and have invested over $15,000,000 in these undertakings. In a paper read before the meeting, Mr. Bellamy, of Liverpool, discussed the question of half-penny fares, and statistics which he gave showed that these would not, as a rule, be desirable. He pointed out the importance of securing from the British Board of Trade the privilege to increase the speed, which is now limited to 6, 8 or 10 miles an hour under different conditions. He believes that the double-deck cars used in Great Britain are desirable for the conditions in that country, and that a careful system of checking the receipt of fares by conductors is very important. Another paper, read by Mr. Fell, of Sheffield, dealt with "Power Stations." He believes that the installation of very large generating units at the start is undesirable, and that the station should be so arranged that two-thirds of the plant installed will carry the maximum load. He then discussed some of the possible economies in power-station operation, such as automatic stokers and oil separators, and in conclusion gives some statistics as to the cost per kw-hour and "per passenger carried" of his power station.

Some notes on American tramway systems were presented by J. B. Hamilton, of Leeds, in which were given some observations made during a trip of about 20 days through some of the principal cities in the United States. Referring to rail joints, it was stated that the cast-welded joint is giving very good satisfaction. Electrically-welded joints are being used in Buffalo, in which city there are over 3,000 joints of this kind. The number of joints broken since the contractors removed their welding plant has been about 1 per cent. The electrical return has been very much improved, and the Buffalo company is very well pleased with its electrically-welded rails. Repairs of car equipment are nearly all done at one point on a system; about one man to every seven cars is the rule. Labor-saving appliances are the rule, and repair work is nearly all 'one on the piece-work system. Very little or no laying-off time is allowed at the end of the lines. The men are usually paid by the hour. The maximum speed between stops in cities is not greater in most American cities than in Great Britain, but a higher average speed is attained, due to quick acceleration.

Electrical Utilization in St. Louis.

Much space is given to statistics on overhead and underground wires and cables in the annual report of the Supervisor of City Lighting, submitted to the Board of Public Improvements of St. Louis, Mo. Last year 38.889 miles of cable and 22,519 duct feet were laid by all companies. The report states that there are 361.896 miles of trolley wire and about 300 miles of high-tension wires of the electric light and power companies. There are 985.913 miles of pole lines, exclusive of trolley lines and 62,512 poles in streets and alleys, including trolley poles. There are 18,370 trolley poles. The telephone, telegraph, light and power companies have 44,142 poles, many of which carry high tension wires. From April 5, 1897, to April 1, 1902, the following progress was made in burying wires and cables; Trench feet, 1,162,916; duct feet, 3,864,024; feet laterals, 256,334; miles of cables, 388.157.

The accident list shows that six deaths were caused by contact with live wires; sixteen persons were shocked by the same cause; one death was caused by falling from a pole, and six persons were injured in this way.

The electric railways occupy 209.886 miles of street; 361.896 miles of track are operated; there are 361.896 miles of trolley wire, and 19,107 poles. The Transit Company utilizes 190.548 miles of street, operates 325.821 miles of track, has 325.821 miles of trolley wire and 17,865 poles. The Suburban utilizes 19.338 miles of street, operates 36.075 miles of track, and has 36.075 miles of trolley wire.

The cost of street lighting in 1901-1902 was $498,729.92, as compared to $416,080.95 in 1900-1901, and the cost of lighting public buildings $66,285.62, as compared with $95,799.49.

Combined Railway and Central Station Plant for Wilmington, N. C.

A power installation of more than ordinary novelty is in process of installation at Wilmington, N. C. The Consolidated Railways, Light and Power Company is at present operating a small lighting and street railway service in this city, and has acquired the properties of a suburban road of approximately 12 miles in length, running from Wilmington to an attractive summer resort, Wrightsville Beach, on the Atlantic Coast.

This road is now operated entirely by steam, and it is the purpose of the company to change the motive power to electricity and operate both urban and interurban systems from a single power house located in Wilmington. The power for present uses is generated in two separate power houses, which were originally operated by the two companies forming the consolidation, representing gas, electric lighting and street railway interests, respectively. These plants will be abandoned and a new power house constructed, which will furnish power for city and suburban railway, incandescent and arc lighting. A substation has been built about 1.5 miles from the beach terminal and nine miles from the city, in which will be located apparatus for converting the 10,000-volt alternating current used on the transmission lines, to 550-volt direct current for furnishing motive power to the suburban cars. The accompanying illustration gives a diagram of the system.

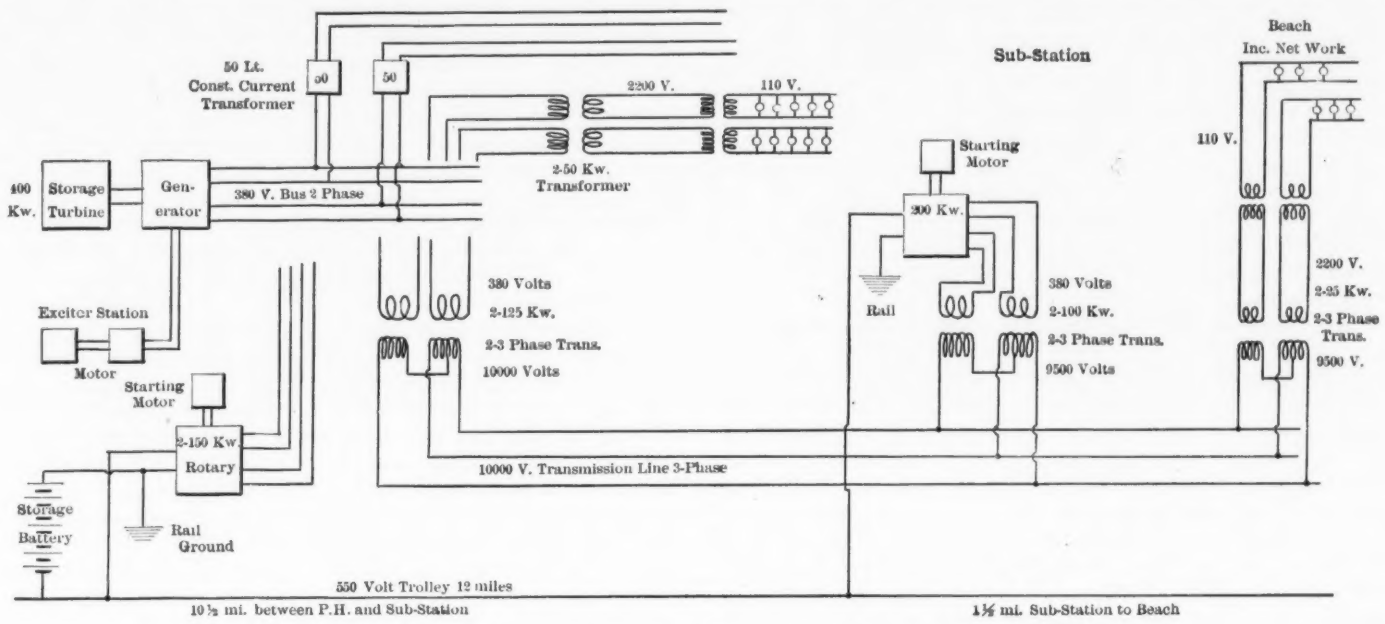


DIAGRAM OF THE WILMINGTON COMBINED RAILWAY AND CENTRAL STATION SYSTEM.

The item of greatest interest outside of the somewhat novel combination of railway and lighting service contemplated by the company, is the installation of a 400-kw Westinghouse steam turbo-generator as the main power unit, which will ordinarily furnish the entire motive power of the proposed plant. The turbine equipment will be supplemented by a reserve of reciprocating engines for the purpose of furnishing power during emergencies or on very light loads. The turbine will be of the multiple-expansion, parallel-flow type, the present standard type of the Westinghouse Company, and will operate at 150 lbs. steam pressure on 26-inch vacuum with no superheat. The approximate dimensions will be 4½ x 19 feet, and the combined weight 25,000 lbs. The turbine will be provided with a by-pass valve connecting high-pressure and low-pressure steam chests, by means of which an overload of 50 per cent. may be carried continuously. Steam will be furnished by two 250-hp B. & W. boilers, arranged for hand firing. The condensing outfit will be of the most approved and efficient type and capable of sustaining continuously 28-inch vacuum.

The generator will be of the two-pole, rotating field type, direct connected by means of a flexible coupling to the turbine, and will generate two-phase alternating current at 380 volts. Part of this current will be stepped-up by two-phase, three-phase transformers to 10,000 volts, three-phase currents for the transmission system, a second part converted into 550 volts direct current for the local railway system by two rotary converters located at the power house, and the remainder utilized for the local lighting system, comprising two 50-light constant-current arc circuits and a 2,200-volt incandescent distributing network. The generator will be excited by a small direct-current machine, direct connected to an induction motor operating directly on bus-bars.

Arrangements will be also made for exciting the alternator field directly from a storage battery in case of accident to the regular exciting unit. This storage battery will be located in the power house at Wilmington, and is designed to serve the two-fold purpose of a floating battery and power reserve for emergencies. Its output will be controlled by a differential booster set.

The rotary converters to be installed in the power house will be provided with induction starting motors and also with extended shafts for belting to the engine reserve if necessary. They will then operate as double-current generators, furnishing alternating current to the transmission line and lighting systems, and direct current to the local trolley system, being assisted in this respect by two Edison bipolar machines now in use. These converters will be of 150 and 200-kw capacity, respectively.

The sub-station will contain one rotary converter set with oil-cooled transformers and switchboard. This station will also contain two two-phase, three-phase lighting transformers stepping down to 2,200 volts, for supplying a lighting feeder extending along the right of way to the Beach. The lightning protection of the entire system involves the use of choke coils and the low equivalent arrester system.

The rolling stock of the suburban line will be of the double-truck interurban type, 41 feet in length, equipped with two motors and controllers. The cars will make a scheduled speed of approximately 15 miles per hour. The new city cars will be equipped with Westinghouse motors.

Wrightsville Beach is one of the most attractive resorts on the southern coast, and the elimination of the steam service will greatly enhance the value of both the railway systems and terminal properties.

The consulting engineers for the Consolidated Company are Mr. H. R. Randolph and Prof. W. L. Robb. All the electrical apparatus will be furnished by the Westinghouse Electric Manufacturing Company.

To Transmit Messages to Ships at Sea.

The Marconi Company of America announces that it has established direct connections all over the United States with its shore stations, and is prepared to receive messages for transmission to all vessels equipped with its instruments. It is expected to thus make it possible for all the great steamships plying between Europe and America to keep in touch with the world as well as with each other. Every Postal Telegraph office is an office for the Marconi business.

Central Station Depreciation.

One of the most interesting discussions at the recent Cincinnati Electric Light Convention dealt with methods of determining the actual depreciation of central station plants, and the timeliness of the topic as well as the need of definite ideas and information was well illustrated by the diversity in the views expressed.

Mr. W. L. Abbott expressed the opinion that electrical apparatus depreciates much faster than we realize, if it is considered that besides wearing out the chances of apparatus becoming obsolete must be taken into account. Apparatus that has been used in the business for the last 15 years has not had an average life of over 6 or 8 years. Mr. Abbott said he found in making an estimate for depreciation, his figures are always higher than those of anybody else, which perhaps is because he has been in the business longer than most other people who figure on depreciation. While depreciation is not so rapid now as in the past, it should not be taken at less than 15 or 20 per cent. during the first few years; after that the depreciation will be correspondingly less. Mr. I. B. Smith, of Cedar Rapids, Ia., said that depreciation will vary from 2 per cent. up to 10 per cent. for different classes of apparatus, depending on what the apparatus is. On the power house many companies consider that two per cent. is a fair depreciation. A point to be considered also aside from actual wear and tear is that apparatus may either decrease or enhances in value. The last few years has actually shown an increase in the value of some electrical apparatus, whether it is old or new. To adopt any particular system will give rise to complicated problems, and it may be better to guess at it and see how one comes out.

Lieut. James B. Cahoon, of New York, took issue with Mr. Abbott on the question of making the depreciation 15 per cent. for the first five years of the use of electrical apparatus. While this was perfectly true of electrical apparatus in the past, it is not true of the electrical apparatus sold to-day. The question of depreciation is a new one, comparatively speaking. It has been the custom of many companies in the years gone by to let depreciation look after itself, and they have run along declaring dividends when they could, and all at once had to meet the issue that their apparatus was obsolete, or had gone to pieces and had to be replaced, with no depreciation fund to cover this expense. The English method of setting aside a definite amount for depreciation, and placing that at interest, is better than any of the methods adopted in this country. Some engineers here have advocated shaving off 5 per cent. on certain pieces of apparatus and carry it along at 5 per cent. for the whole period of its life. Then certain engineers have recommended that if we set aside five per cent. for depreciation, this should not be put into a bank, but considered a fund against which should be charged improvements and betterments, so that the value of the plant shall remain the same at all times; in other words, thus keep the plant up to the same general level of efficiency as in the first place, or keep the plant always at 100 per cent. That is to say, instead of charging improvements and betterments to the construction account, they are charged against this depreciation fund.

Mr. Cahoon considered that the best plan would be to take each piece of apparatus of to-day, estimate its life and therefore rate of depreciation; then set aside annually, say, at three per cent. an amount which at that rate of interest will equal the original cost of the apparatus. If this plan were carried through for each class of apparatus, engines, boilers, dynamos, buildings, lamps, lines, etc., etc., a pretty fair estimate would be arrived at as to the depreciation.

Mr. W. L. Abbott said that to further illustrate his previous remarks, suppose the case is taken of a new direct-connected unit costing $100,000—a generator connected to reciprocating engine. The next year we may find that we can get a unit of the same output as economical as the reciprocating engine, in a turbine unit, for, say, $70,000. It would then be quite proper at once to write off $30,000 for depreciation, or 20 per cent. After that, depreciation would not be so rapid.

Mr. Arthur Williams said that many engineers allow nothing for depreciation on the ground that repairs and renewals offset the depreciation. But in an isolated plant you must charge off depreciation either through several years or in the last year, and it is important to have an established rule. This question was brought up at the meeting of the American Institute of Electrical Engineers at Boston in 1899, and the general feeling was that ten per cent. on the cost of any electrical plant was a fair depreciation charge annually. Nothing was said as to whether it should be at single interest or compound interest. The New York Edison Company's charge is eight per cent. which represents 12 years of life, the depreciation coming about in several ways—through the wearing out of machinery, or its profitable replacement by other forms of machinery, and also by the limitation of the useful life of the machinery due to greater competition of the central station companies; this competition increasing by lower manufacturing costs on the one hand, and the increase in efficiency of translating devices, such as the Nernst lamp, or the substitution of arc lights for incandescent lights, on the other hand.

Mr. Leonard Andrews, of Hastings, England, said that this is a question which has been discussed in England for some time. There is in Great Britain an association of municipal electrical engineers, the managers of municipal stations, and during the last few months they have been discussing this question of depreciation pretty fully. But a short time ago at a meeting of practically all the members of the association, it was almost unanimously agreed that if about three per cent. per annum were set aside for depreciation, that would be sufficient. Of course, the depreciation is not at the same rate as here, as plants are not scrapped quite so quickly.

Mr. Charles R. Price, of New Bedford, Mass., agreed with Mr. Williams that when it comes to the substitution of incandescent arcs for the old open arc, it practically results in scrapping machines which cost several thousand dollars, and therefore ten or fifteen per cent. is a safe depreciation charge per annum. In reply to a question Lieut. Cahoon said that if a company takes the betterments ordinarily put into a plant from year to year, and instead of charging that off to construction account, charges it to maintenance and operation, it is for all practical purposes maintaining the plant at 100 per cent. Referring to Mr. Abbott's statement in regard to charging off on a $100,000 plant $30,000 because some turbine comes up to replace the ordinary reciprocating engine, Lieut. Cahoon said he did not think that is doing justice to the plant. The difference in efficiency between the steam turbine, so far as we know at the present time, and a first-class reciprocating engine, is not great enough to warrant that amount being charged off. No plant can stand such a heavy charge being made against it any one year. If it is thought desirable to charge off, it should be charged to expense account and distributed over five years; otherwise dividends are deferred, stockholders will make objection, and a small plant cannot stand such a system. Mr. Harry Bottomley, of Bellows Falls, Vt., said that the Gas and Electric Light Commission of Massachusetts when estimating in their annual returns the cost of lighting in municipal plants, add in as a factor of the cost of the lighting the sum of five per cent. on the total capital invested as a depreciation fund. Mr. D. F. McGee asked if on the basis of 10 per cent. depreciation, and a plant worth $100,000 when it is installed, and if improvements are made to the amount of $5,000, should the value of the plant at the end of the first year be $90,000 and the next year ten per cent. written off from that amount? In reply Mr. Arthur Williams said that if the plant cost $100,000 and during the first year $5,000 in improvements were made, then the total cost of the plant is $105,000, and at the end of the first year 10 per cent. on $105,000 should be written off.

A motion was made to the effect that it is proper to charge off to depreciation 10 per cent. annually on electrical and mechanical equipment, and a similar motion was made placing the percentage at seven and one-half per cent. Some opposition having developed the matter was referred to a committee for report. Subsequently in answer to a question as to whether a distinction should be made between boiler and engine room, or whether they should be classed as a whole, President Doherty said he thought they should be distinct; that every piece of apparatus should be distinct. There are no two classes of apparatus that will depreciate at the same rate, nor are there any two makes of apparatus that will depreciate at the same rate. Mr. J. Walter Gillete, of Evansville, Ind., said that in his experience depreciation has been more rapid in the boiler room and the pipe room—at the steam end of the plant—than in the dynamo room where proper care has been bestowed on that end of the plant.

Old Time Telegraphers.

The Old-Time Telegraphers have issued a circular of their meeting for the twenty-second annual reunion, at Salt Lake City, on September 10, 11 and 12. The U. S. Military Telegraph Corps will meet as usual at the same time. The local committee has as its chairman Mr. C. B. Horton, assistant superintendent Western Union Telegraph Company, Denver. Headquarters will be at the Kenyon.

English Municipal Railways.

In his address as president of the Incorporated Municipal Electrical Association, which was delivered at the seventh annual convention of that body, held in London last month, Mr. J. H. Rider pointed out that in the United Kingdom there are 36 electric street tramways in operation which are owned by municipalities, and 16 more in progress of construction. The overhead trolley system in England, as in America, occupies the field almost entirely to the exclusion of other forms of construction, and Mr. Rider expressed the opinion that under present conditions there is no reason why all the street railways of Great Britain should not be operated by the trolley system, and that there can scarcely be any excuse for the introduction of other systems. He admits that the overhead construction in some of the English towns is not as attractive as it should be; in fact, that it is often ugly in appearance, but he points out that this is a fault of the designer and not of the system, as it is perfectly easy and practicable to design and erect an overhead line which will look well in almost any locality. One of the principal difficulties in designing neat overhead construction is the use of guard wires, which are called for by the rules laid down by the board of trade and the local authorities. Instead of affording additional protection, he considered that these guard wires are not only cumbersome and unsightly but they are often a source of positive danger. The only practical solution of the problem Mr. Rider believed to be the placing of the telephone wires under ground, which will remove the necessity, or rather the excuse, for guard wires.

The Investments in Telegraphy and Telephony.

The financial organs of Boston and New York have recently had some very interesting figures as to the relative investment value of the shares of the American Telephone and Telegraph Company, the Western Union Telegraph Company and the Commercial Cable Company. Owing to the fact that a considerable portion of the share earnings of the American Telegraph and Telephone Company is not reported, but remains in the treasuries of the sub-companies as undivided earnings, the actual earnings on the shares of the parent company have been more or less a matter of conjecture, thus making an accurate comparison with other companies very difficult. There is a method, however, by which we may figure the approximate share earnings of the Telephone Company. Subscribers in central districts, like New York and New England, pay about $60 per annum, and in the West about $30 per annum. The average number of Bell subscribers in the United States in 1901 was 1,119,706. Assuming that the average amount paid by each subscriber was $45 per annum, the gross telephone business of the country in 1901 was about $50,400,000. Of this amount, $6,000,000 represents the direct gross operations of the American Telephone and Telegraph Company in its long-distance system. Approximately one-half the remainder, or $22,000,000, represents the parent company's share in the business of the sub-companies.

All disbursements of the sub-companies before dividends average about 70 per cent. This would leave the parent company's share of surplus earnings at about $7,000,000, or 30 per cent. of $22,000,000. That this figure cannot be far from correct is shown by the fact that in 1901 the American Telephone and Telegraph Company received in dividends from the sub-companies $4,988,208, and companies paying, say, $5,000,000, may fairly be assumed to be earning $7,000,000, or the ratio of 7 per cent. earnings to 5 per cent. dividends. It is probably safe, therefore, to estimate the amount of the American Telephone and Telegraph Company's undivided earnings in the treasuries of the sub-companies for 1901 at a round $2,000,000. Having settled this point, the three companies, American Telephone and Telegraph, Western Union, and Commercial Cable, may be compared on the same basis.

Since the last report, Dec. 31, 1901, the telephone company has issued $21,937,000 new stock on the basis of one new share for every four outstanding, so that the amount outstanding at the time of the issue of new stock was $87,748,000, against $82,836,300 at the close of the fiscal year. Apparently about $5,000,000 was sold from the $32,110,200 held in the Bell Company's treasury.

The capitalization of the three companies as outstanding at present compares as follows:

	Am. Tel.	*West. Union.*	*Com. Cable.*
Stock outstanding	$109,685,000	$97,370,000	$13,333,300
Bonds outstanding	15,004,500	19,660,000	20,000,000
Total capital	$124,689,500	$117,030,000	$33,333,300

The total selling values of the companies in the market, taking the bonds of all three companies at par, compare as follows:

	Am. Tel.	*West. Union.*	*Com. Cable.*
Price of stock	$ 165	$ 87	$ 160
Market value of shares	180,980,250	81,711,900	21,333 280
Bonds at par	15,004,500	19,660,000	20,000,000
Total selling value	$195,984,750	$101,371,900	$41,333,280

Taking gross earnings of the telephone company at $28,000,000, as estimated above, and net earnings at $2,000,000 more than shown in the report for the last fiscal year, the operations of the three companies can next be compared. Western Union's figures below are for the year ended June 30, 1901; those of the other two companies are for the year ended Dec. 31, 1901:

	Am. Tel.	*West. Union.*	*Com. Cable.*
Gross earnings estimated	$28,000,000	$26,354,150	$3,592,129
Expenses and interest	18,601,715	20,625,062	*2,061,166
Net earnings	$9,398,285	$5,729,088	$1,530,963
	7½ per cent.	5 per cent.	8 per cent.
Dividends paid	$5,050,023	$4,868,007	$1,066,664
Surplus	$4,348,262	$861,081	$464,299

Western Union's gross earnings may be expected the coming year to fall off slightly on account of the loss of the Pennsylvania lines. The amount of decrease in net earnings will depend upon the cost of operating these lines, whatever that may have been. A Western Union official has declared that operating expenses on these lines were quite equal to the receipts.

Adding to Western Union's figures the gain in surplus for the six months to Dec. 31, share earnings and the returns to an investor figure as follows:

	Am. Tel.	*West. Union.*	*Com. Cable.*
Price	$165	$87	$160
Dividend to price, per cent.	4.54	5.74	5.00
Earned on par value, per cent.	8.56	6.38	11.47
Earned on price, per cent.	5.18	7.33	7.16

The return on American Telephone shares has been calculated on the basis of the present amount of capital stock. To indicate the real earnings of the shares, apart from rights, there should be taken the amount of stock outstanding last year. On the $82,836,300 stock outstanding Dec. 31, 1901, earnings were 11.2 per cent., or about 6 per cent on the price at 185. It is not singular that the earnings of the American Telephone Company show a lower return on the price. A low return to the investor is an almost sure indication of the gilt-edged character of a security.

Although the ratio of earnings to price is larger for Western Union and Commercial Cable, it is held to be doubtful if these stocks will yield so large a return in the next five years as American Telephone. Rights of 10 per cent. to 15 per cent. may be expected each year on the shares of the latter company, so that in five years an investor may be receiving 7½ per cent. on stock whose net cost has been reduced by subscription rights to about par.

Experimental Physics.

The Société Francaise de Physique has authorized the compilation of a work under the auspices of the Société, to be entitled, "A Collection of Elementary Experiments in Physics." The co-operation was invited of the members of the Société in the preparation of this work, which will cover both lecture and laboratory experiments. The requirement is that the experiments shall be such that they can be made in a small laboratory not supplied with special apparatus.

* Includes $150,000 to reserve for repair steamer, etc.

Recent Progress in Electrochemistry.

By Clinton Paul Townsend.

REDUCTION METHODS.

Two patents of the current issue deal with the reduction of oxids, the one, granted to Ramon Chavarria Contardo, of Santiago, Chili, depending upon the heat developed by the arc, and the other to Dr. Frederick C. Weber, of Chicago, upon the reaction, either exothermic or endothermic, of aluminum. The methods differ utterly in character, but are alike in that the object of the improvement in either case is to bring the reaction under complete control. In this

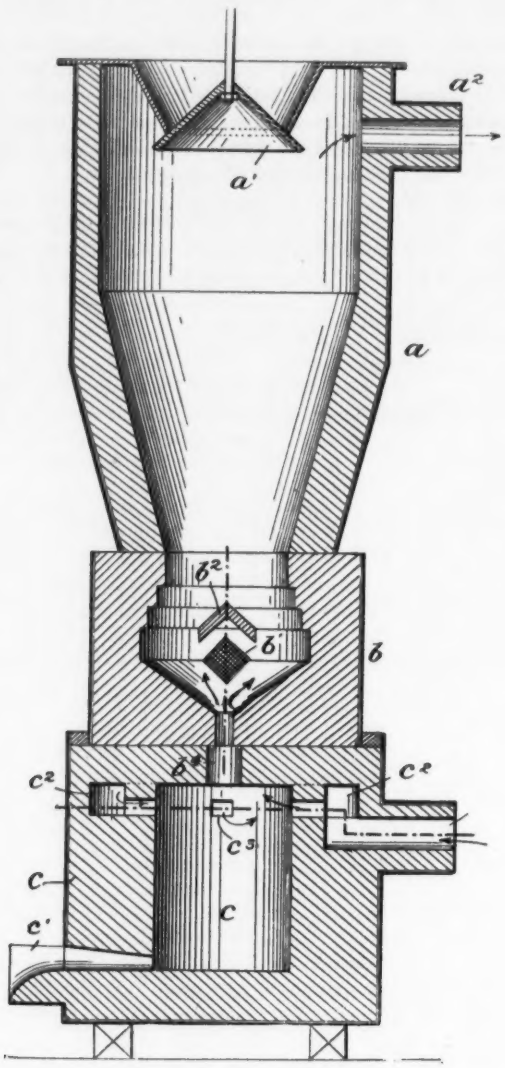


FIG. 1.—CONTARDO'S METHOD OF REDUCING IRON ORES.

they are illustrative of recent inventive attitude toward high temperature reductions; the accomplishment is assumed, and the object sought is a regulated continuity.

REDUCTION OF IRON ORES.

In the direct production of iron or steel from the ore three elements are to be considered, namely, a source of heat, a reducing agent and a carbon supply. In the ordinary blast furnace the combustion of carbon performs these three functions, whereas Chavarria Contardo's plan is to render them entirely independent of one another. To this end the temperature is reached through the agency of an arc, so protected from the charge that the carbon of the electrodes cannot enter into the reduced metal; the reducing agent is a gas which cannot influence the carbon content; and the carburetting agent is another gas, the quantity of which is subject to exact regulation. The apparatus comprises a stack, a, smelting hearth, b, and a crucible, c; the carbons, b^1, extend diametrically through the smelting chamber and are protected from the charge by an angular refractory cover, b^2. The stack is provided with the usual charging bell, a^1, and gas outlet, a^2, and the crucible with a tap or cast, c^1. In operation the ore, unmixed with any reducing agent, but containing a suitable flux, is charged into the stack, and the heat conveyed to it by radiation from the arc and by convection by the reducing gas, hydrogen or carbon monoxid, introduced through the flues, c^2, c^3, b^4. Through the same flues flows a hydrocarbon gas in quantity determined by the desired carbon content of the resulting product.

REDUCTION BY ALUMINUM.

Dr. Weber attributes the occasional explosive violence of the "thermite" reactions largely to the presence of water, free or combined, in the reducible oxid, and avoids the difficulty by a preparatory treatment through the agency of electrically applied heat; for initiating the reaction, it suffices to fuse a portion of the aluminum, and this is accomplished by its inclusion in a second circuit. The objects attained are thus a regulation of the reaction and the avoidance of a contamination of the product by the base of an easily reducible oxid such as is ordinarily used, with aluminum or magnesium, for producing the initial high local temperature. The arrangement of the charge is shown in the accompanying figure, in which A is a metal crucible, B a lining of graphite or of lime, and C an additional lining of mineral wool, mixed if desired with lime or magnesia. In the bottom of the crucible is a spiral, a, of fine aluminum wire connected in the circuit D, d; this wire is surrounded by its atomic equivalent of an oxid, g, in a state of very fine division. A sheet of tissue paper, f, separates this oxid from the main charge comprising granulated aluminum in admixture with the oxid, such as boron trioxid, to be reduced. In this main charge also, atomic proportions of oxid and aluminum are observed, the weight of the main aluminum helix, b, and of a supplemental crucible lining, c, of aluminum, being

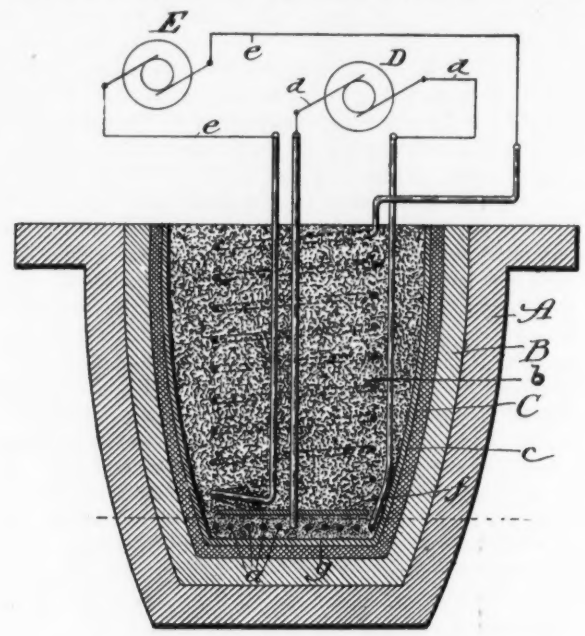


FIG. 2.—WEBER'S METHOD OF REDUCING ALUMINUM.

considered in estimating the proportions. This large helix of aluminum is included in the circuit E, e, and in operation sufficient current is passed to thoroughly dry and otherwise prepare the charge, whereupon by shifting the current through the smaller helix, a, the wire is fused and its reaction with the surrounding oxid, g, initiates the general reduction; as the reaction spreads rather slowly through the coarse mixture it is possible to add additional quantities as required. It is stated also that by heating the mixture by means of the main helix to a temperature just short of the fusing point of aluminum, reactions may be obtained with oxids which require for their reduction a higher temperature than is furnished by the oxidation of aluminum.

Wireless Telegraphy in Italian Navy.

It is announced from Rome, under date of August 4, that the Government has ordered Marconi apparatus to be placed on all Italian warships.

A Telephone Relay.

The issue of the Patent Office for July 29 contains two telephone patents, both, however, referring to the same invention, which is a strikingly original method of reinforcing telephone currents imposed upon long lines. This invention is due to Mr. Joseph Lyons, of Washington, D. C., and the patents are assigned to the American Telephone and Telegraph Company. The original application was filed September 2, 1899, and was divided, and a second application covering the system and apparatus (the first covering the method) was filed April 23 of this year. The invention is based on that of Hutin and Leblanc of a machine for reinforcing alternating currents by causing them to produce an alternating field, within which field are rotated closed circuits at a speed exceeding a certain critical speed. Rather than risk destroying the interest of the description of Mr. Lyons' highly ingenious system let him speak for himself:

"The reinforcing of the faint telephone currents I accomplish by reducing the apparent resistance of the line to those currents continuously and practically to any desired extent. In accordance with my invention the telephone currents are primarily caused to produce an alternating field or fields of force varying in frequency and intensity with the frequency and the variations of intensity of the telephone currents, and within such field or fields there are rotated electric circuits that are closed upon themselves with a speed that exceeds a certain critical speed. By the rotation of such circuits within the initial magnetic field or fields the electro-magnetic reactance of the telephone-circuit is reduced, whereby the initial field or fields and the exciting-currents are reinforced.

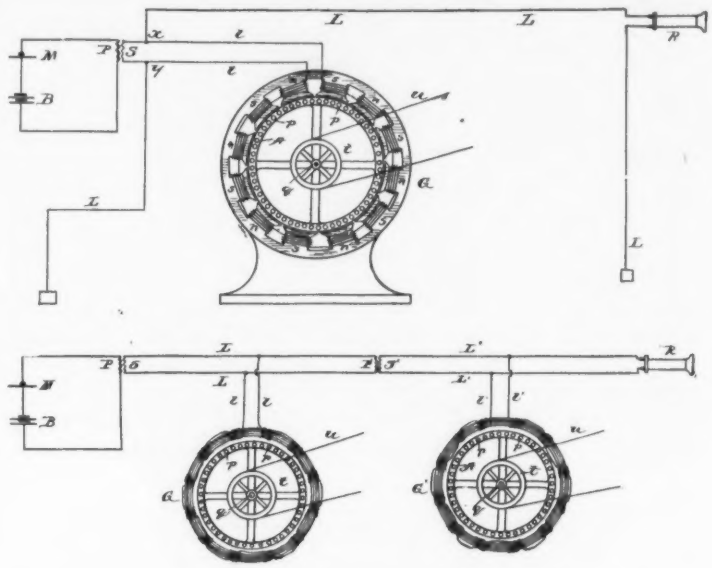
"Machines for reinforcing faint alternating currents of one definite frequency by causing them to produce an alternating magnetic field or fields and rotating within the latter circuits closed upon themselves with a speed exceeding a certain critical speed, have heretofore been suggested for use as constant-potential alternating-current generators, and such machines are set forth in United States patent to Hutin and Leblanc, No. 606,762, dated July 5, 1898. Such machines, however, have heretofore been used only each for the reinforcement of an alternating-current of one definite frequency, and the speed given to the closed circuits was calculated and determined with reference to the frequency of the single current that was led to and reinforced by the machine.

"The rule which governs the operations of such machines is that if the frequency of the alternating current led to the machine is designated by $\frac{1}{T}$ and if the number of poles of the field excited by these currents is designated by $2n$, then in order that the initial field and the initial current be reinforced, the number of revolutions of the circuits closed upon themselves must exceed the quantity $\frac{1}{n\,T}$. This rule may also be stated in these words: The number of rotations of the rotor must exceed the frequency of alternations of the alternating current that excites the stator divided by half the number of poles of the latter. My invention is based upon the utilization of the principle embodied in these reinforcing generators for the reinforcement of multiperiodic varying currents—that is to say, the reinforcement of telephone currents.

"In the practice of telephony alternating currents of constantly-varying periodicities and intensities are generated, and it has been found that the currents corresponding to the highest pitch of sounds uttered against the telephone transmitter rarely exceed the frequency of 800 per second. All other frequencies that occur in practice are below 800 per second. In order to reinforce alternating currents of the frequency of 800 with a machine of the Hutin and Leblanc type, if the same has, for instance, twelve field poles, the circuits closed upon themselves have to be rotated at a speed exceeding one hundred and thirty-three revolutions per second. If this is done, then not only the currents having the frequency 800 will be reinforced, but all other currents of a lower frequency will also be reinforced and upon the recognition of this fact my invention is based.

"Accordingly my invention is practiced by passing the faint telephone currents at any point on the line through the field coils of a machine of the Hutin and Leblanc type and rotating the armature of such machine with a speed exceeding the number of periods of the highest frequency current that occurs or is likely to occur in telephony divided by half the number of poles of the field-magnet. By this process the lower-frequency currents are more reinforced than the higher-frequency currents; this does not vitiate the reproduction of speech, but, on the contrary, improves it, since lower-frequency vibrations must be of higher amplitude than those of higher frequency in order to produce sounds of the same intensity as the latter."

In the drawings the upper one illustrates the invention applied to an unbroken line, and the lower one to a line divided into sections. The usual local telephone circuit is shown, *M* being the transmitter, *B* battery, and *PS* induction coil. At two points, *xy*, the line is tapped by wires *ll*, leading to and completing the circuit of the field-coils of a reinforcing alternating current generator of the Hutin and Leblanc type above referred to. This reinforcing-generator *G* is ordinarily composed of a stationary iron field-ring having inwardly projecting radial pole-pieces *ns*. The pole-pieces are wound alternately reversed and are here shown as connected in series (although they may be connected in multiple arc), so that a current which produces in one pole-piece a north pole will produce in the next succeeding and in the next preceding pole-piece a south pole. This is indicated in the drawings by the letters, *ns*. The rotary part of the reinforcer is ordinarily made of an iron ring, faced on each side with a flat annulus, *A*, of copper, and the iron ring as well as the two copper rings are perforated, so as to receive copper pins, rods, or bars *p*, riveted at each end to the copper rings; all in the manner now well known and set forth in detail in the Hutin and Leblanc patent above referred to. The copper rings, *AA*,



LYONS TELEPHONE RELAY.

together with the pins *p*, form a great number of electric circuits of low resistance closed upon themselves, and this system is secured upon a spider, as indicated, and the whole is mounted upon a shaft *q*, carrying a pulley *t*, around which passes a belt *v*, by which motion is given to the shaft from any suitable source of power.

In the lower figure the main line is divided into two parts, *LL* and *L'L'*, connected inductively by the induction coil *P'S'*. In each branch there is a reinforcing machine, *GG'*. This division into sections, which may be carried much farther, permits the use of small reinforcing-machines upon moderately long sections of lines and the practice of telephony over very long distances. It is not necessary that the sections be all metallic or all grounded, nor that the two or more reinforcing machines be all driven at the same speed. It is sufficient if each machine be driven above the critical speed indicated; so long as this rule is observed it is immaterial what the speeds of the reinforcing-machines are. The system operates as follows: Speech uttered against the transmitter, *M*, causes alternating currents to be generated in the secondary *s* of the induction coil. One branch of these currents passes through the field coils of the reinforcing-machine by *ll* and another passes to the line *LL*. Both current branches are exceedingly weak, and the branch passing to the line is too weak to cause an audible reproduction of sounds in the receiver, *R*, if the line exceeds a certain length; but if now the rotor of the reinforcing-machine is rotated with such speed that its number of rotations per second exceeds the number of periods of the current due to the sound of highest pitch that is uttered against the transmitter divided by half the number of poles of the field, then the initial and exceedingly weak alternating field excited by the telephone currents is reinforced, and

those currents themselves are reinforced. This reinforcement of telephone currents may be carried practically to any desired extent, depending upon the size and speed given to the reinforcing generator and also depending upon the electromagnetic reactance of the reinforcer. This reactance should be made as small as practicable and for this purpose the amount of iron entering into the construction of the machine should be made very small, and the iron, if employed at all, should be highly laminated, as is usual with machines of this character. The reinforcing machine may be in series in the line instead of in a branch derived therefrom.

Mr. Lyons says that while the invention is well-adapted for use in connection with the ordinary magneto telephone receivers, it is preferable to use telephone receivers without iron or steel cores, and, similarly, it is preferable to use induction coils without iron cores. Altogether the electromagnetic reactance of the system should be made as small as possible.

It will be interesting to see the results attained by Mr. Lyons' system in actual practice. While difficulties may develop through the distortion of some currents and through noise from the machines being introduced to the line this is certainly a highly ingenious and original solution of the telephone relay problem.

Large Power Plant for Wyoming.

The Edison Electric Company has filed incorporation papers at Cheyenne, Wyo. The company is composed of Chicago and San Francisco members of the Wells-Fargo Express Company and the concern is capitalized at $10,000,000, $6,000,000 of which is preferred stock and $4,000,000 common stock.

The company proposes to establish a large power and light plant somewhere in the vicinity of Evanston in the southwestern part of the State and in the Uinta oil fields, and furnish light and power to the towns that are building around those fields. The company will also build and operate electric railways, furnish power to run the drills and pumps in the oil fields, and also transmit power to distant mining camps, such as Park City, Utah, and possibly to Ogden and Salt Lake City. The concern will also operate lumber mills in the mountains and prepare material for building.

The incorporators and leading officers of the Edison company are Andrew Cooke, Maurice K. Baker and Peter A. Tagg.

CURRENT NEWS AND NOTES.

MARCONI AND WIRELESS TELEGRAPHY.—A Boston newspaper quotes Prof. Elihu Thomson as follows: I believe Marconi is entitled to all the credit he has been given for wireless teleggraphy. He has done the practical work and developed the theory. Others have theorized on it, but Marconi has put the thing to practical use. I have given this matter a good deal of study and I am convinced that Marconi deserves all he has got.

LONDON TUBES.—A cable dispatch from London, of July 28, says: The Parliamentary committee dealing with Charles T. Yerkes's proposed tube transportation system for London, to-day elicited the fact that only £2,000,000 out of £5,000,000 stock of the new District Road is held in America. Sir. Lewis McIver, Bart., chairman of the committee, said he did not care where the money came from as long as it was good money. Mr. Yerkes testified that it was his intention to give the British workman as much of the electrification work as possible, and to buy all materials in England except the ironwork, which would come from Germany. He believed two pence should be the universal underground fare for the metropolis.

NEWS BY TELEPHONE.—The Lafayette (Ind.) Telephone Company has recently instituted an "Information Desk," for the benefit of its 1,700 patrons. This obviates any difficulty that may arise by reason of "no telephone directory," forgotten or misplaced spectacles, or subscribers not in telephone directory. Patrons in a "great hurry" may also obtain connection by request of the "information desk." A call made to central asking for "information desk" will be promptly complied with. The following information may be obtained on request made to the "information desk": Arrival and departure of all trains; correct time of day; base ball news and all other sporting events; election returns; theatre attractions; weather indications; location of fires; telephone numbers of the subscribers.

LIGHTNING IN CHICAGO.—It is stated from Chicago that since June 1 over 500 buildings in that city have been struck by lightning. Of these, over 400 were struck in July. This is believed to break all records. The electrical storm, which began July 7, struck 68 buildings, 28 on the evening of the 7th, and 40 after midnight. This, however, was far surpassed by the storm of July 17, when 127 strokes were reported. That these figures do not begin to measure the number of times lightning struck in Chicago during July is shown by the fact that they are taken from the record of adjusted insurance losses reported to the fire insurance patrol. For weeks the insurance adjusters have been complaining of the number and size of the lightning losses they were being called on to pay. Up to July 31, 418 lightning losses had been reported, with an aggregate loss to the companies of $31,782.

BRITISH TELEGRAPH EFFICIENCY.—The confessed inefficiency of the British Post-office telegraph service is revealed in a circular of instruction to the effect that a considerable percentage of the 3,000 operators employed in the central office at London are inexperienced and inefficient, and directing operators at outside offices to adapt their rate of working to the capacity of the receivers in the central office. Mr. Austen Chamberlain, financial secretary to the Treasury, endeavored to explain the matter in the House of Commons on the theory that there must always be many recruits employed, but older telegraphists deny this, and point out that years of instruction were required formerly, while now only three months' preparation is exacted before actual service is begun. The inefficiency, it is claimed, is due wholly to new economies undertaken in the department, since plenty of efficient employees are available. It is considered extraordinary that in the entire telegraphic service no typewriters are used, except in a few instances, in the foreign departments.

AUTOMOBILES IN JAPAN.—Mr. E. C. Bellows, U. S. Consul General at Yokohama, reports that up to date 13 automobiles had been imported into Japan, where it is not likely the machine will ever be as popular as it is in Europe. There is, however, a fair prospect that automobiles may gradually come into use for purposes of business. The postal authorities are now considering the advisability of purchasing automobiles for the transportation of the imperial mails at Tokyo. The mails are now carried in wagons or carts, each drawn by a single horse. The Government must keep several relays of these horses, which are a continual source of annoyance and expense. Should the postal authorities decide to buy automobiles, those that are run by steam would be considered objectionable because of the real or fancied danger of fire to the imperial mails. At present, gasoline is exceedingly expensive in Japan, but plans are in progress for its manufacture. If these plans prove successful, gasoline will undoubtedly become as cheap as in America, and its use for generating motive power will increase rapidly.

MANHATTAN FIRE ALARM.—Mayor Low, of New York City, has decided to sustain Fire Commissioner Sturgis in revoking the permit of the Manhattan Fire Alarm Company, on the general ground that such a relation between a private company and the city is contrary to public policy. The mayor says, however: In view of the fact that this decision affects injuriously a considerable investment made upon the faith of the city's permit, although that permit was revocable by its terms; and, in view of the further fact that the device controlled by this company is valued by many as an additional protection of their premises against fire, I have suggested that the city might be willing to enter into negotiations for the purchase of the company's plant, with a view to the city's giving this protection itself. The company has notified me that it will confer with me on the basis of my suggestion. Before any action is taken, the matter will require careful consideration, and, eventually, legislation, in order to make my suggestion practicable. If after consideration, this plan appears to the city to be wise, it can then be carried out. In the meantime, the whole subject will be carefully investigated.

INDUCTANCE COILS FOR TELEPHONE CIRCUITS.—Two patents issued July 29 to John C. Lee relate to inductance coils such as are employed for reducing the distortional and attenuating effect of telephone lines. The specifications state that two main requirements of such coils are that the resistance of the winding shall be

low and the inductance high. The latter may be fulfilled by using a core of iron, but when coils containing iron cores are employed in circuits carrying telephone currents the development of eddy currents is thereby facilitated, thus giving rise to adverse effects in telephonic working. The object of the present invention is to provide a practical substitute for iron. This is done by making the core of magnetic oxide or of ferroso-ferric oxide (Fe_3O_4). Thin plates or ribbons or very small wires of iron are assembled, lapped or wound into a loosely-built or partly openwork structure corresponding in form and dimensions to the core desired. This structure is then submitted to the action of heat in an atmosphere capable of yielding oxygen to the iron until the iron is reduced or converted into magnetic oxide. The core thus made is thus composed of artificial magnetic oxide, and while retaining the form in which it was originally built up, has become condensed, continuous and compact. It is stated that such a core possesses in a high degree the desired qualifications of permeability and high specific electrical resistance, and in consequence of the latter, has no tendency to serve as a circuit for the development of eddy currents.

LETTERS TO THE EDITORS.

Submarine Cables as Accessories to Land Telegraph Lines.

To the Editors of Electrical World and Engineer:

Sirs.—In the recent correspondence on the telegraph situation in the United States, it seems to me that the value of submarine cables in maintaining communication during the periodical collapses of the landline system has not received the attention which it deserves. This value will be sufficiently illustrated by the fact that New York has never been cut off from Europe during at least the last ten years, and the system of cables in the North Atlantic is so complete that the probability of such a thing happening is extremely remote.

The question of coast cables to maintain telegraphic communication between London and Scotland during the annual breakdowns of the aerial lines has already been ventilated in England, and there are many who think that such cables would be a more satisfactory solution of the problem than underground cables. There are, naturally, many points to be considered before it could be said that a system of coast cables would be useful, reliable and economical in the case of the United States, and most of these points could only be decided by those in possession of the requisite data.

There may be some doubt as to the suitability of the submarine cable for emergency work, but I think it may fairly be claimed that a submarine cable of the present type is not very inferior in actual work to a landline of equal length, provided the lengths are moderate. The traffic carrying capacity of a telegraph circuit is necessarily greatly dependent on the electrical stability of the line, and when one considers the violent electrical changes to which aerial lines are subject, more particularly during storms, the practical failure of automatic systems when most required is not surprising. On the other hand, the electrical condition of a submarine cable is practically stable and automatic working is successfully and extensively used.

Then, again, we are probably within measurable distance of considerable improvements on the lines of Prof. Pupin's patents, and it is evident that the electrical stability of the submarine cable will allow of the application of the inductance coils under the most favorable conditions, provided mechanical difficulties can be overcome. Distortionless circuits so constructed would be ideal lines for high speed automatic systems, and, wherever practicable and advisable, would prove invaluable in promptly handling a large amount of traffic when suddenly called on by a collapse of the aerial-line system.

LIMA, PERU. A. DAVIDSON.

The Thunder Storm.

To the Editors of Electrical World and Engineer:

Sirs.—In my letter on thunder storms which appeared in your issue of July 12, 1902, I stated I believed that heat, initial charge and a rotation of some kind are necessary for the production of thunder storms. In what follows I propose to give some reasons for the above conclusions, more especially why a rotation is necessary.

If a cloud acts simply as a condenser and no rotation is necessary, there appears to me to be no reason why other clouds in the neighborhood should not be thunder clouds also, or that a thunder cloud should remain one until dissipated and not cease as such, as it often does. It cannot be that the other clouds do not receive initial charges, for the air being well charged with electricity, they certainly should become charged also by induction. If a rotation is necessary for a thunder cloud, all is explained. In the one case the non-thunder clouds have not been thrown into a rotating or tumbling motion by the wind, and in the other case the thunder cloud ceases as such when the rotation has been spent.

As regards the combination of drops of water into larger drops raising the potential, in the first place consider how small is the radius, and consequently the surface, of a drop of water. It does not appear possible that such a minute surface as a drop of water by combination with others, which must result in but a small increase, could raise the potential and current strength of a discharge to such great proportions as to give rise to a spark miles in length. If the drop discharges are "in parallel," if such an expression is permissible, the potential of the discharge could not be higher than that of a single drop of water. If the drop discharges are in series, which I do not think is a supposable case, the current strength of the discharge could not be more than that of a single drop. The rending of trees, melting of metals, etc., all show a great potential as well as great current strength. If the cloud is charged as a sheet and is in rotation, all is clear as explained above. I think it likely that clouds which do not discharge to earth during a thunder storm may be charged, but their potential is too low to discharge of itself to any great distance. The thunder cloud may discharge to the cloud not in rotation, but the cloud not in rotation takes but little part in the spark, the spark coming from the thunder cloud almost entirely.

If a thunder cloud consists of separately charged drops of water of a high potential, how could the cloud hold together? The repulsion between the separate drops would be considerable, and the cloud would be quickly scattered by the repulsion on the outside drops. Any part of the cloud that would have drops opposite each other charged in the opposite sense, would be forced together, and that part of the cloud would be a solid mass of water. Sometimes a great number of clouds are seen near each other, and flashes of lightning are seen between them, but no thunder is heard. In this case I assume that the clouds are charged as sheets, and possibly discharge comparatively short sparks between each other; there may be some small cloud having a tumbling motion near them, but the cloud is too small to produce discharges to earth.

BALTIMORE, MD. ALFRED G. DELL.

Alternating Current Hydro-Mechanical Analogies.

To the Editors of Electrical World and Engineer:

Sirs.—Such hydro-mechanical analogies as those presented by Professor Eddy in your issue of July 26 are especially interesting to me. In all essential points, I have used the same analogies in the class-room. I have presented to my students the double-acting cylinder and piston with the pipe leading out from one end and back into the other as an imaginary apparatus that could be made to illustrate accurately an alternating sine wave flow. I have pointed out that an elastic pipe would affect the flow as capacity does an electric current; and I have shown that by substituting a heavy liquid for a light one we could simulate the effects of self-induction. But the student who is to get a correct idea from the analogy should, I think, be impressed at this point that self-induction is a property of the circuit or the conductor itself, as much as are the resistance and the capacity. An induction coil can be represented by a rotary type of water motor, inserted in the pipe and having a flywheel of perceptible inertia attached to it. Such an arrangement becomes a part of the conducting circuit, and does not require any modification of the liquid flowing in the conductor to change the apparent inertia of the flow. Moreover, if the waves of this motor and its flywheel rotate without any friction, it represents an air-cove induction coil, while if the apparatus has friction this may be taken to represent hysteresis in an induction coil, and most appropriately so, since it is a different kind of friction from that between the liquid and the pipe, but one that affects the flow exactly as if the other friction had

been increased. Thus it accurately represents the way in which hysteresis seems to increase not the reactance of a circuit, but its ohmic resistance.

Byron B. Brackett.

Rutgers College, New Brunswick, N. J.

Free Lamp Renewals.

To the Editors of Electrical World and Engineer:

Sirs.—It was much to be regretted that the time available at the last convention of the National Electric Light Association did not permit the reading of papers in the discussion "Are Free Lamp Renewals Desirable?" This discussion quite positively and clearly demonstrates that free lamp renewals are desirable, and this fact is shown even in the arguments advanced by those opposing the idea.

Some of the arguments advanced against free lamp renewals are thorough boomerangs, and I should like to call special attention to one offered by Mr. H. J. Greene, which is both illuminating and amusing. Mr. Greene states that he opposes free lamp renewals because "the rapid increase of business, in the face of hard competition with gas, being difficult to provide for with increased capacity, owing to manufacturing delays and engineering difficulties, makes any check to growth, as may result from charging for lamp renewals, desirable."

In other words, Mr. Greene agrees that unless free lamp renewals are supplied, the growth of the lighting business is checked and retarded. No better argument, it seems to me, could be offered in favor of free lamp renewals.

Harrison, N. J. F. W. Willcox.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Induction Motors.—Rothert.—A communication referring to the controversy between Eborall and Meyer, recently noticed in the Digest. Eborall is of the opinion that squirrel-cage rotors should not, as a rule, be used beyond 5 hp or 8 hp, this limit depending upon the starting load. Meyer argued in favor of a more general use of the squirrel-cage rotor, preferably in connection with compensators. This difference of opinion is said to represent the difference between European Continental and American practice. The present author says that in the early days of polyphase working the squirrel-cage motor enjoyed the same favor on the Continent as it does now in the States, but Continental experience is in favor of even a stricter rule than that of Eborall. "Squirrel-cage rotors are invaluable for small motors for mining work in general—but with exceptions—and in many special cases, but they never ought to be used where a rheostatic motor presents more advantages, and this can only be decided by experience. Continental experience, which is older and more extensive than American, speaks in favor of Eborall and against Meyer."—Lond. *Elec.*, July 11.

Induction Motors.—Meyer.—Another communication in which he continues the discussion on the relative advantages of squirrel-cage and slip-ring induction motors. He admits to Eborall and Rothert that the squirrel-cage motor, like the rotary converters, requires considerable discretion in its installation, otherwise it is liable to give trouble, which tends unjustly to prejudice the public opinion against it. This he has found to be the case on the Continent of Europe, where, probably due to some faulty installation made in the early days of the art, both the squirrel-cage motor and the rotary converter are avoided in a great number of cases where they are successfully used in the United States. In regard to the efficiency of polar-wound motors when compared with squirrel-cage motors, he agrees that theoretically the former, neglecting the slip-ring losses, should have as good or even a better efficiency than the latter, which has to start, say, under 30 per cent. of full load torque, with not more than full load current. However, in actual practice, most of the standard slip-ring motors, even of the very best Continental make, show a poorer efficiency than the corresponding squirrel-cage motors, this result being due to the desire of every designer to obtain a motor which is cheap to manufacture. He explains this a little more in detail. He hopes that the development in English mining and mill work will offer an opportunity to prove that the Continental views in this direction are too conservative to be "the best engineering practice."—Lond. *Elec.*, July 18.

Electric Pumps.—A well illustrated description of high pressure electrically-driven centrifugal pumps of Sulzer Bros., used in a Spanish mine; 250-hp, three-phase induction motors, running at 850 to 900 r. p. m., are in use; the voltage is 1,000; the short-circuited armature has been adopted.—Lond. *Eng'ing*, July 18.

REFERENCES.

Double-Current Generators.—Ruthven-Murray.—A paper read before the Brit. Mun. Elec. Assn. He describes in general the construction of double-current generators and states that there will soon be at least four electric plants in Great Britain using these machines. In the discussion which followed, C. F. Scott, of Pittsburg, participated.—Lond. *Elec., Elec. Eng.*, July 4. An editorial referring to Ruthven-Murray's paper. It is said that had these machines been thought of 10 or 15 years ago, the uneconomical employment of the single phase system of distribution would never have obtained the foothold which it has acquired, as the main argument in favor of it was that it rendered accessible those districts which are distant from the station. The double-current system would often have been employed, with direct-current distribution near the station, and alternating current in the distant parts.—Lond. *Elec.*, July 11.

Flywheels for Alternators.—Begtrup.—An article illustrated by diagrams, in which he gives the formulas for calculating the weight of a flywheel required to keep the small periodical variations of the speed of direct-connected alternators within given limits. Numerical examples are added.—*Am. Mach.*, July 10.

Efficiency Tests.—The first part of an illustrated article on direct-current dynamos.—*Elek. Anz.*, July 6.

Power.

Steam Turbines.—Jedden.—An abstract of a paper read before the Brit. Mun. Elec. Assn. He expresses his confidence in the steam turbine for large sizes—200-kw to 300-kw and upwards—and not small sizes, provided that surface condensers are used. The large steam consumption recorded in the early day were, he believes, due to the turbines being small and running non-condensing, and he is convinced that the larger steam turbines now on the market can hold their own in the matter of steam consumption against any triple-expansion engine yet produced. Besides a good vacuum, a high degree of superheating is a condition which he considers important. In the discussion which followed, Kilgour agreed with the author as to the advantages of steam turbines over reciprocating engines, but did not agree with him that they must be in large sizes and be run with surface condensers. Concerning the cost, Martin, of the Parsons Company, state that the cost of small sets, say up to 100 kw, was about the same as of the best quality of reciprocating engines, and those of larger size were cheaper. Wordingham and other speakers referred to the commutator difficulty on direct-current turbo-generators, stating that the commutators of turbine-driven machines wear very rapidly, and that it is impossible to use carbon brushes, as they catch fire on account of the friction at the high speed of the engine. Ferranti, in criticizing the steam turbine, admitted that it was all the fault of the dynamo, but thought that neither for direct nor alternating current could turbine-driven generators compare with those driven by moderate-speed engines. Several speakers discussed the question of wet steam; the result was that steam turbines will run without trouble with very wet steam, but at a much lower efficiency than if the steam is dry. Andrews, of Hastings, said he had found that a 500-kw turbo-alternator takes no more steam on the very light day load which they have than other machines of 100 kw. He had found that his Parsons

machines, would run in parallel with Mordey alternators.—Lond. *Elec.*, July 4.

Steam Turbines and Power Stations.—A long editorial referring to Fedden's recent paper. He is said to have been amply justified in equipping the new Sheffield plant with 1,500-kw steam turbo-alternators. It is expected that before long recognized and common practice will sanction not merely 1,500-kw units, but turbo-alternator sets capable of developing double or treble this power. The steam turbine is a better engine the larger its size. It is too early to say whether for electricity supply purposes or for electric traction it is likely to exceed some 5,000 hp, but, in the utilization of steam turbines in the naval and mercantile marine, it is not unlikely that larger turbine engines even than this size will be built before many years have elapsed. The importance of superheating for the steam turbine is emphasized. Not only in mere steam economy, but also in heat economy, superheating has the advantage over dry saturated steam. Steam turbines in electric stations enable one to save money in many ways. The question is asked why steam turbines are not in more general use, and it is answered that this is due not only to the "inherent conservation to which British engineers are only too liable," but also to the fact that the steam turbine is not sufficiently pushed in a commercial way.—*Lond. Elec.*, July 18.

Engines for Generating Stations.—DAY.—An abstract of a paper read before the Brit. Mun. Elec. Assn. on "the correct type of engine for large generating stations." He favors the slow-speed horizontal engine on account of its low steam consumption, and maintained that the question of space occupied is not important with large units. He thinks that the question of an even turning moment has been made too much of, and states that there are "single-crank, three-phase machines" on the Continent with a variation in the angular velocity of 0.3 per cent. In the discussion which followed, Ferranti said that if people were prepared to pay for horizontal engines and the larger buildings they require, excellent results can be obtained, but taking the interest and sinking fund into account, the less efficient vertical engines are cheaper in the end.—Lond. *Elec.*, July 4.

REFERENCE.

Thury D. C. Series System.—GUILBERT.—The first part of a very long and well-illustrated description of the electric power transmission from St. Maurice to Lausanne with the Thury system, which has already recently been noticed in the Digest.—*L'Eclairage Elec.*, July 12.

TRACTION.

Arnold System.—Arnold's recent A. I. E. E. paper, in which he proposed the use of a single-phase, alternating-current system for electric traction, with the aid of compressed air, is abstracted, and the following remarks are made on the system: "In his system both the armature and the field of the single-phase motor may rotate, the former going when the train is running, and the latter when it is stopped. Mr. Ferranti suggested this a very long time ago, but got no further with it. He proposed to start the train by simply braking the revolving field till it stopped. Assuming the mechanical difficulties overcome, there is, therefore, sheer waste of power at all intermediate speeds below synchronism. Mr. Arnold makes his revolving stator store energy by compressing air, and a start is made not by a friction brake, but by throttling the air-compressing engine. Incidentally, since this engine can run backwards and drive the field in the same direction as the armature, the speed of synchronism is not the maximum speed. Also, the train can be run on its store of compressed air alone, if for any reason it be desired to omit the overhead conductor for a short distance. It is amazingly pretty, but, at first sight, it looks very like adding the weight and expense of a compressed air locomotive to the train. Mr. Ward-Leonard and his friends add that of a motor-generator instead."—Lond. *Elec. Times*, July 17.

Mountain Railway.—An illustrated article on the electric railway of Bex-Gryon-Villars, in Switzerland. This line is divided into three sections, two operated by adhesion and a central portion fitted with a rack rail. The cars are operated by direct current of 600 volts by an overhead wire. The power station is located near the middle of the heaviest grade, which greatly simplifies the distribution of current. Both motor cars and electric locomotives are used on the road, but only the latter are fitted with pinions for service on the rack section, and the motor cars are not aiding on this section. The motors of the locomotive are connected to the rack-pinions by intermediate gearing, effecting a total speed reduction of 8 to 1. Under all normal conditions the descent of the rack section is made with the motors reversed and acting as dynamos. The current which they generate is turned into a large rheostat built up of corrugated iron and placed in the center of the car, directly over the motors. To prevent this rheostat from overheating an electric fan is installed to blow air through it, and the current connections are so arranged that the fan is automatically set in operation whenever the locomotive is descending, but it is switched off when it stops or runs up grade. For emergency use, the locomotive is also equipped with two-hand-brakes acting upon the rack-pinions; also a hand belt-brake for the motors, and a screw-brake acting automatically upon the motors when the normal speed of 7.5 miles per hour is expected in descending, or when the electric current is intercepted from any cause whatever.—*Le Genie Civil;* translated in *Eng. News.*, July 17.

REFERENCES.

Electrolysis of Pipes in Alternating-Current Traction.—See the abstract on Alternating-Current Electrolysis under Electrochemistry.

Multiple-Unit System.—P. L.—A continuation of the illustrated serial. This article deals with the Auvert system.—*L'Ind. Elec.*, June 25.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Indicator of Synchronism.—A description of an instrument for paralleling alternators. It is really a non-synchronous motor with identical stator and rotor windings, with two phases for use with single-phase alternating current, and with three phases for three-phase currents. The stator is connected to the network and the rotor to the alternator, which is to be connected in parallel. In the case of single-phase current, the windings of the two phases are connected to two terminals, the one through a non-inductive resistance, and the other through a self-inductance as great as possible, in order to get as nearly as possible a phase difference of one-quarter of a period. It is so arranged that the magnetic fields produced in the windings of stator and rotor revolve in the same direction. It follows that at synchronism the rotor remains at rest in space, and that it turns in one direction or the other when one of the fields revolves more quickly than the other.—*L'Ind. Elec.*, July 10.

St. Petersburg.—MULTHAUF.—An illustrated description of the central station of the Electricite and Hydraulique Company, in St. Petersburg. This is one of three electric plants of about equal size, the three cable networks of which, for private light consumers, cover the same area, while for street lighting the city is divided. The two other plants are that of Siemens & Halske, where 2,000-volt, three-phase current is used, and that of the Helios Company, with single-phase current. The station of the Electricite and Hydraulique Company (a Belgian company) is intended to have a capacity of 7,000 kw, 20 generating sets each of 350-kw being planned, 15 of which have been installed. Single-phase current at 2,000 volts, with a frequency of 42.5 periods per second is used. For the total length of the network—about 300 km.—concentric cables with rubber insulation are used, the outers being earthed. Transformers are placed in the houses.—*Elek. Zeit.*, June 19.

High-Tension, Direct-Current Systems.—BARNARD.—A paper read before the Brit. Mun. Elec. Assn. He endeavors to show that for pressures of 2,000 to 3,000 volts, at least, there are some advantages to be gained by using direct current for both transmission and distribution. He describes the experience which he has had at Hull, where the main generators are of the four-pole type, coupled direct to high-speed engines, and giving an output of 510-kw each, at 2,250 volts. From their satisfactory behavior he thinks there should be no difficulty in designing dynamos for very much larger outputs at the same or higher pressure. He says that the direct-current generator is cheaper than the three-phase alternator, and that a direct-current, high-tension to low-tension converter sub-station needs less attendance than an alternating direct-current converter sub-station. In Hull the converters in the substations are started and stopped and entirely controlled by an attendant at the central switchboard in the generating station. The "long-range" switch consists of a single-pole, low-tension switch, whose moving part is actuated by an electromagnet, the coil of which is placed in circuit, through a pilot wire, with a voltmeter at the generating station. By short-circuiting this voltmeter the resistance of the whole pilot-circuit is sufficiently reduced for a predetermined current of, say 5 amperes, to pass. This is enough to attract the armature of the electromagnet, and in so doing to close the low-tension side of the converter. In Hull, three-core pilot wires are used—one wire being connected to the negative

low-tension mains (which are also permanently connected through a plug-board to the negative side of the converters), one to the positive low-tension main, and one to the positive side of the converter. By means of a two-way switch at the generating station the attendant can assure himself that the e. m. f. of the transformer is the same as that of the mains before operating the long-range switch. The third pilot wire is a valuable adjunct, as while it is necessary to have one wire permanently showing the pressure on the mains, yet, in the event of a breakdown when the low-tension mains were "dead," there would be no power available on that wire to operate the long-range switches. With the three pilot wires from each, a number of converters may be started up and switched simultaneously on to the "dead" network, although they are fixed in sub-stations possibly a couple of miles apart. In the discussion which followed, Snell doubted whether alternators are really more expensive than direct-current dynamos, and said that the advantages claimed thus resolved themselves only into the saving of superintendence in sub-stations. He said, an engineer should give the matter most serious consideration before he decided to have a sub-station with running machinery and without an attendant to look after it. Wyllie, of Walsall, said he had found the high-pressure, direct-current system reliable; he employs one man, "a junior," to look after all nine of his sub-stations, and this man has time to do other work, such as putting up meters, as well. Ferranti said that the only thing that direct-current is necessary for, is for lifts, say, 3 per cent. of the total energy; the single-phase system has the advantage of saving both capital and works' costs, by establishing a uniform system without complications.—Lond. *Elec., Elec. Eng.,* July 4.

REFERENCES.

Preventing No-Load Loss of Transformers.—SCHMIDT.—A very long article, illustrated by diagrams. To prevent the no-load loss in transformers when they are not used, a "high-voltage, long-distance switch" has been introduced by Schnecker & Co., by which the primary coils of the transformer are disconnected, when it is not to be used. This switch has already been noticed in the Digest. In the present article a number of different connections, which can be used for this article, are described. It is thought that no special difficulties will be experienced with it in practice.—*Elek. Zeit.,* June 12, 19.

Rules.—A reprint of the regulations of the Association of German Electrical Engineers for underground electric installations in mines; also of the regulations for electric installations in theatres.—*Elek. Zeit.,* June 5. (See editorial comment this issue ELECTRICAL WORLD AND ENGINEER.)

WIRES, WIRING AND CONDUITS.

Three-Wire Systems.—SNELL.—Some brief notes on a Brit. Mun. Elec. Assn. paper, in which he endeavored to show that the three-wire system of distribution is "an over-rated thing," and that a simple two-wire system is preferable. In the discussion, Ruthven-Murray claimed that the figures which are worked out in support of this contention are based on a wrong assumption, namely, that of equal current density in the network instead of equal percentage fall of volts. Snell's case was that the actual economy in the conductors arrived at by using the three-wire system is counterbalanced by the trouble of balancing, and the incidents arising out of the necessity of a balanced load, by switchboard complications, less reliability of supply, and, finally, by the increase of leakage from the negative pole by using an earthed middle wire.—Lond. *Elec.,* July 11.

Earthing.—PROCTOR.—A brief note on a paper read before the Brit. Mun. Elec. Assn., in which he seems to recommend earthing the middle wire of a three-wire system at several places instead of only at the station, and furthermore to insert fuses in the middle wire, whatever the conditions of earthing or not-earthing. In the discussion the speakers did not favor earthing of the middle wire at several places, on account of the desirability of being able to remove the earth connection for testing purposes. The opinions concerning the whole question of earthing and fuses were greatly divided.—Lond. *Elec.,* July 11.

REFERENCES.

Aluminum Lines.—IZART.—An article in which he compares copper and aluminum for transmission lines, and gives formula for the most economical current density. His conclusions are in favor of aluminum. —*L'Ind. Elec.,* July 10.

Calculating Line Wires.—CAHEN.—A further mathematical communication, in which he continues his discussion with Teichmueller on the calculation of line wires for economy.—*Elek. Zeit.,* June 5.

ELECTRO-PHYSICS AND MAGNETISM.

Limits of the Graphical Treatment of Alternating-Current Problems.—TEICHMUELLER.—A mathematical article. The method of treating alternating-current phenomena graphically by means of vector diagrams, starts from the assumption of pure sine waves. The author investigates whether the graphical method is also correct for any wave form. He first shows that in general for any wave form the average real power and the apparent volt-ampere power can be represented as the hypothenuse and one side of a rectangular triangle, while the cosine of the angle between both lines represents the power factor. He then discusses the geometrical addition of the vectors representing several impedances in series. In the general case for any wave form, the rule of the geometrical addition of the vectors is here correct only if the product of self-inductance and capacity has the same value for each impedance; the rule is generally valid if all impedance have only resistance and self-inductance, or if all have only resistance and capacity. He then discusses the rule of geometrical addition of the vectors of the admittances of several circuits in parallel; in the general case of any wave form this rule is valid only if the power factors of all the circuits in parallel are equal; if these circuits contain only resistance and self-inductance, or only resistance and capacity, the condition is that the inductances are proportional to the resistances, or if the capacities are inversely proportional to the resistances. He thinks there is every reason to doubt the reliability of many results obtained by the graphical treat ment of alternating current problems.—*Phys. Zeit.,* July 1.

Phase Difference.—ORLICH.—A mathematical article on the definition of phase difference for any wave forms of e. m. f. and current. He first refers to the usual definition of the phase difference as the angle, the cosine of which equals the ratio of real power to the volt amperes. He remarks that in special cases this definition is not suitable. He recommends the following more exact definition: First, under the given conditions calculate the time integral of the product of e. m. f. and current over a whole period, and divide by the time of the period; this gives a value A; then displace the e. m. f. curve against the current curve, without changing these curves, until the value of A becomes a maximum which may be called B; then the phase difference is defined as the angle, the cosine of which is the power factor, and is given by the ratio of A to B.—*Elek. Zeit.,* June 19.

Steinmetz Hysteresis Formula.—DOERY.—A highly theoretical paper in which he arrives at Steinmetz's well-known formula for the hysteresis loss by purely theoretical considerations from Maxwell's theory. The exponent 1.6 appears here as twice the ratio of the distance between the poles to length of the magnetized rod. This ratio varies, according to Kohlrausch, between 0.81 and 0.85. If it is assumed to be 0.8, the exponent becomes 1.6, as in Steinmetz's formula. According to the strict theory, the coefficient of hysteresis and the exponent should depend somewhat on the density of magnetization.—*Zeit. f. Elek.,* July 6.

Lenard Rays.—DURACK.—An account of experiments in which he measured the velocity of the Lenard rays as the pressure of air in the discharge tube was altered. The velocity varied from 5,000,000,-000 cm. per second for the high discharge potentials to 3,200,000,000 for the lower; none of the velocities measured was smaller than this, but probably higher velocities could be obtained with good discharge-tube insulation. He also investigated the variation of the ionization produced by the rays with the pressure in the discharge tube, the charge in the Lenard-ray current under the same circumstances, and the ionizing power of the Lenard rays.—*Phil. Mag.,* July.

Hall Effect.—BAKER.—An account of an experimental investigation of the Hall effect in gold for weak magnetic fields. His results show that it is a constant, at least for all fields between 12 and 21,500 c. g. s. units.—*Phil. Mag.,* July.

Magnetostriction in Bismuth.—WILLS.—Bidwell had found that when a bismuth rod was magnetized lengthwise under a gradually increasing magnetic field, an extension could be measured, the effect increasing much more rapidly than the field; the maximum field used by him was 842 c. g. s. units. The present author has studied this effect under higher fields. The arrangement for measuring any possible change in length of the bismuth cylinder consisted of a system of two levers and a high power micrometer microscope. In these experiments the field was varied, reaching a maximum of 3,200

c. g. s. units; but neither with the maximum field nor with any of the various intermediate fields could any effect be detected, which was not due to one of the following two causes: either a heat effect, in which case time was required to produce it, or an effect due to the action of the magnet on the currents induced in the levers themselves; in the latter case a sudden jerk was observed when the magnetic circuit was made or broken, and the pointer would return to its zero position immediately. This effect was much more marked when the circuit was broken than when it was made.—*Phys. Rev.*, July.

REFERENCES.

Magnetostriction.—NAGAOKA AND HONDA.—A very long account of an experimental investigation of the magnetization of steel, nickel, cobalt and nickel-steels; the change of length by magnetization in steel ovoids, nickel ovoids, cobalt ovoids, reversible nickel ovoids and reversible nickel-steel wires; the effect of mechanically elongating cobalt and nickel-steels on magnetization, and the reciprocal relations with the change of length; the change of volume by magnetization in steel, nickel, cobalt and nickel-steel ovoids; the Wiedemann effect in iron, nickel and nickel-steel wires.—*Phil. Mag.*, July.

Discharge of Positive Electrification by Hot Metals.—STRUTT.—An account of experiments which show that the discharge of positive electrification by hot metals can be detected at much lower temperature than has hitherto been supposed, becoming apparent very far below a red heat, and increasing rapidly with the temperature.—*Phil. Mag.*, July.

ELECTRO-CHEMISTRY AND BATTERIES.

Alternating-Current Electrolysis.—TROTTER.—A note on experiments, in which he passed a small alternating current between two lead surfaces a few inches apart, and separated by moist earth, and observed the effect on the lead after a protracted period. First two 18-inch lengths of 1¼-inch pipe were laid parallel to one another about 6 inches apart, and a current of 1 ampere at a frequency of 83 was passed between them. The pressure was 100 volts, the dampness of the earth being adjusted to maintain 1 ampere. A distinct and sharply defined incrustation on the lead, evidently due to electrolysis, was observable in six weeks. It was confined on each pipe to about 45 sq. in. This effect was then compared with that of still lower current densities by burying a series of plates in the same way, the first plate having a surface of ¼ sq. in. exposed—the remainder of the plate being painted—the second a larger surface, and so on up to 9 sq. in., the current sent through the series being 0.000625 ampere, so that the current density at the surface of the first plate was 0.025 ampere per sq. in., the same as on the pipes, and on the last 0.000694 ampere per sq. in. The incrustation on the first plate was comparatively thick, and even on the largest plate of 9 sq. in. surface, showed slight but unmistakable signs of corrosion. The outermost faces of the series of plates showed only very slight traces of corrosion. This latter effect was observed after four weeks. The earth used was taken from the garden in front of his office. He regards the result as a proof that alternating currents will electrolyze lead pipes at current densities lower than 1 ampere per sq. in., and he considers that the burden of determining the amount of this electrolysis should rest with those advocating electric traction by alternating currents.—Lond. *Elec.*, July 11.

Probable Source of the Heat of Chemical Combination.—T. W. RICHARDS.—A paper in which he brings forward the very suggestive generalization that the contractions exhibited during different chemical combinations are in many cases approximately proportional to the heats evolved; hence he believes that the chief source of heat of chemical combination is the work performed in compressing the material. On the same basis he gives an explanation of the mechanism of the heat of absorption, adhesion and change of allotropic form. He is led, from these consideratons, to the hypothesis of compressible atoms, which is given in detail and with applications.—*Proc. Am. Acad.*, v. 37, p. 399; *Zeit. Phys. Chemie*, v. 40, p. 597; briefly abstracted in *Am. Jour. Sc.*, July.

Silver Electrodes for Alkali Storage Batteries.—A description of a patent of Gahl, who makes porous silver oxide electrodes (as used in the Jungner cell), as follows. Fused silver chloride is mixed with about 15 to 20 per cent. of lead chloride. To remove the chlorine, the plate is used as cathode in an alkaline hydrate solution; afterwards the lead is removed by using the plate as anode in another solution (not described), whereby the lead is dissolved and deposited on the cathode, while the silver is oxidized.—*Centralbl. f. Accum.*, July 15.

REFERENCE.

Troubles with Stationary Batteries.—WEHRLIN AND LANGSTEIN.—An article in which they discuss the different troubles experienced in the use of stationary batteries, and the various reasons of the gradual destruction of the plates.—*Centralbl. f. Accum.*, June 15, July 1.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Standard Cells.—JAEGER.—An abstract of a paper read before the German Electrochemcal Society. A standard cell must represent a reversible chemical system and would theoretically have the best forms, if the electrolyte is also present in solid form, for instance solid crystals of zinc sulphate with water of crystallization in the Clark cell. The depolarizer is best when solid and a good conductor. When mercurous sulphate is used, there are complications due to its solubility. He gives some results of tests of Clark cells and Weston cells obtained in the German Reichsanstalt, where nearly every year a greater number of Clark cells and Weston cells (with solid cadmium sulphate) are compared for e. m. f., and the ratio of the e. m. f. of these two cells is determined. This ratio has not changed in four years by more than 0.0001. The average of all the measurements in these four years is as follows: The ratio of the Clark cell at 0° C. to that of the Weston cell at 20 degree is 1.42280; the ratio of the Clark cell at 15° C. to that of the Weston cell at 20° C. is 1.40669. In the cadmium cell, made by the Weston Company, the electrolyte is not saturated and is not present in solid form; its e. m. f. is nearly independent of the temperature and is higher by about 0.0005 volt than that of the cell with solid form at 20 degrees; the e. m. f. of the latter is 1.0186 volt.—*Centralblatt f. Accum.*, July 15.

Measuring the Angle of Lag and the Power Factor with a Voltmeter.—MAYER.—A brief communication referring to the article of Hanchett in ELECTRICAL WORLD AND ENGINEER, Nov. 2, 1901. If the non-inductive resistance X Y in Fig. 1 of that article is so chosen that the voltage A at its terminals is (arithmetically) equal to the voltage B at the secondary terminals of the auxiliary transformer, a single relation enables one to easily find the phase difference, if the vector sum C of A and B and their vector difference D are measured. A diagram is given showing that then C is perpendicular to D, and the tangent of half the angle of phase difference is equal to the ratio of D to C.—*Elek. Zeit.*, June 5.

REFERENCE.

Permeameters.—ARMAGNAT.—The first part of an illustrated article, in which he discusses in general the methods used in some new permeameters.—*L'Eclairage Elec.*, July 12.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—WIEN.—An investigation of the features of Braun's "coupled" system of senders and receivers in wireless telegraphy, which has been adopted by both Marconi and Slaby. This system consists in exciting the vibrations, not in the strongly damped mast-wire itself, but in a feebly damped primary electric circuit of great capacity; by induction the vibrations are transmitted to the mast-wire which forms the secondary. He gives a very illustrative acoustic analogy to the coupled instrument. The independent exciter corresponds to a tuning-fork, which radiates little energy and is only slightly damped. The mast-wire corresponds to the resonance box, which takes up energy and sends it out. The transmission of vibration from one tuning fork to another is greatly enhanced when both are provided with resonance boxes, though the latter by themselves can possess only very slight energy of vibration. He distinguishes between "loosely coupled" and "closely coupled" systems, which differ by the value of the mutual inductance between the circuits coupled together, this being low in the former and high in the latter. The closely coupled systems are especially adapted for long-distance telegraphy, as the energy radiated is great. The loosely coupled systems radiate less energy, as the damping is great, but, on the other hand, they admit of close "tuning," so that they make simultaneous telegraphy possible. He sketches a system of combined long-distance (single) and short-distance (multiplex) telegraphy which should not interfere with each other. The coast station would be advised by the long-distance system of the approach of a vessel, and could prepare its loosely coupled systems for communication at short range. Of such communications, 50 or so could be carried on simultaneously. The tuning should not be more difficult than that of a good piano.—*Ann. d. Phys.*, No. 7; abstracted in Lond. *Elec.*, July 11.

Wireless Telegraphy with a Relay Telephone Receiver—TAYLOR.—An illustrated description of a relay-telephone receiver for wireless telegraphy, which is very simple and consists essentially of a dry

cell, a high resistance relay and a telephone receiver. While experimenting with single-contact coherers he had used the secondary circuit of a relay, but with rather poor success. The practical difficulty with the relay was, as with other coherers, that decoherence was liable to destroy the adjustment, and the platinum contacts did not seem as sensitive to electrical waves as a nickel coherer. He, therefore, substituted nickel contacts for the platinum, and the result was a very sensitive coherer. The arrangement is illustrated.—*Phys. Rev.*, July.

REFERENCES.

Wireless Telegraphy.—Marconi.—A reprint in full of two Royal Society papers, read by him on a magnetic detector of electric waves, which can be employed as a receiver for space telegraphy, "and on the effect of daylight upon the propagating of electromagnetic impulses over long distances." The principal contents of both papers have already been recently noticed in Electrical World and Engineer.—Lond. *Elec.*, July 18.

Wireless Telegraphy.—A well illustrated description of the system of wireless telegraphy devised by Braun and used by Siemens and Halske.—*Sc. Am. Sup.*, July 5.

Wireless Telegraphy—Turpain.—An illustrated article on recent progress in wireless telegraphy; experiments of Marconi, Slaby's method of tuning, Foresio's repeaters are described.—*L'Eclairage Elec.*, July 5.

Wireless Telephony.—Collins.—An illustrated article on his system of wireless telephony.—*Sc. Am.*, July 19.

MISCELLANEOUS.

REFERENCES.

Canadian Electrical Association.—A full stenographical report of the proceedings and discussions at the recent annual convention in Quebec. The papers by Dion on the use of storage batteries in electric distribution systems, by Lambe on the electrical equipment of an ordinary street car, and by Green on arc lighting, are also reprinted in full, with illustrations.—*Can. Elec. News*, July.

Tait.—MacFarlane.—A biographical sketch, with good portrait, of Peter Guthrie Tait.—*Phys. Rev.*, July.

New Books.

Standard Polyphase Apparatus and Systems. By M. A. Oudin, M. S. Third Edition; revised. New York: D. Van Nostrand Company. 289 pages, 169 illustrations. Price, $3.00.

The appearance of a third edition within three years is an indication, if not of the value of the book, at least of the reception accorded to it. In the preface to this third edition the author states he has taken advantage of republication to bring the work up to date; and this has increased the size of the original book by some eighteen pages, though it has resulted in no essential changes other than the addition of a few illustrations and some minor changes in text.

The inevitable introductory chapter in which the definition of alternating current terms is attempted presents the usual mixture of analytical and graphical notions, which can scarcely be of much service to those readers whose scanty mathematical knowledge precludes an adequate conception of such matters. The art of which this book aims to be an exponent has reached such a stage of development that the title of the book should be adhered to rigidly in the selection of its materials. A reader not otherwise prepared might better be referred to one of several elementary text books for explanations. In the definition of "wattless current," for illustration, the usual statement of the relation in quadrature is given; and though the writer hints at the physical cause of lag or advance, he fails to make clear that such relations follow the establishment and change of the electromagnetic or electrostatic fields of the circuit.

The two chapters on generators are very well handled, and deal not with questions of design, which are really foreign to such a work, but with matters of installation. They lead up in a fair way to those considerations which govern the choice of such machines for a given installation; and are concluded with a good discussion of the particular frequency, to be adopted, and the relations between cost and frequency.

Probably the best chapter in the book is that on Induction Motors; and here the subject matter is well illustrated by numerous diagrams of connections and curves of torque, and such details. The discussion is essentially practical, and the matter is well selected and is representative of best present practice. It is, however, to the disadvantage of the book that this portion has not been enlarged to include more varied types of induction motors, and to contrast American, especially with Swiss and German practice.

The chapter on the Synchronous Motor is brief and inadequate, nor is the discussion satisfactory which has been attempted. The extent to which this type of motor is used, especially in the West, would seem to demand a more explicit and extended treatment. The paragraphs on Torque and Output and on Voltage, pages 95-6, are singular attempts at definition, and are by no means clear and connected; though the Power Factor, page 105, is handled somewhat better. The chapter following, on Rotary Converters, while better in its statements, is yet too brief; nor can the author be considered altogether fortunate in his treatment of the Static Transformer.

A second excellent chapter is that given to Station Equipment and Apparatus, and the writer properly lays stress upon these details; for within the past few years much of the advancement in polyphase working has been in such auxiliaries. But it could be wished that some of the more notable switchboard work by the Westinghouse engineers had received not only mention, but discussion in a fair and impartial spirit. The rather remarkable Mershon compensator is deserving of more notice than that contained in four lines and one illustration. The subject of Current Rectifiers, for instance, is disposed of in some thirteen lines; and Synchronizing Devices is a paragraph much too brief. The well informed author should certainly be aware of the very special thought which has been given to synchronizing and phase indicating apparatus, especially abroad, and could doubtless have given it a more satisfactory treatment. Commendation must be given for the very clear discussion of transformer connections and combination with which Chapter X is introduced. The illustrations and text are remarkably clear on a matter which is not usually given the attention it merits.

Turning to the preface, the statement is made: "The three-phase system has been found to be almost universally applicable. It has largely replaced the two-phase, and to a still greater extent the monocyclic system(s)." This must be conceded to be by no means a fair statement, for the generation and local distribution by currents of two phases, as those must know who are conversant with the subject, has in the past been, and is still very largely used. A second anachronism is the retention of a long chapter descriptive of the hybrid known as the monocyclic system, especially after having averred it has been supplanted in practice.

The book is closed with a good presentation of the choice of frequency, and a chapter covering the usual matter on the calculation of transmission lines. A questionable appendix has been added to this edition, which is neither more nor less than that portion of the report of the committee on standardization of the American Institute of Electrical Engineers, which applies to alternate-current working. A brief and inadequate index is provided.

A loose expression, "electrical degrees," has frequently been used by the author. It is evident that the term "degree" cannot be qualified; and besides the angles so referred to belong to arcs of magnetic and not electrical position. On page 88 will be found a most singular attempt at definition: "The condenser consists of numerous thin sheet conductors, separated by still thinner dielectrics, the whole electrically connected to form two conductors." It is singular that such a meaningless combination of words should have escaped the attention of the author in revision, but it is only fair to assert that the book as a whole should not be judged by such a statement as this. Numerous infelicities of style, too, are found throughout the book. Prominent among these are the "split" infinitive; and just why this particular literary sin should characterize so many excellent engineering works is not readily answered. That however, it is only too general, is shown by works of such prominence and value as Wood's "Thermodynamics" and Johnson's "Materials of Construction," which are notably marred by these blunders in speech. These things are marks of crudeness which must inevitably be laid against the profession and be charged in part to the spirit of commercialism always impatient of everything but the gross results.

The proof has been fairly well read, though on page 94 the word "bunt" occurs, evidently meant for "hunt," while on page 67 the omission of the initial word "The" of a sentence is noted. The book is neatly printed, and the illustrations are well selected, but the half-tones, more especially, are often too large. We are glad to note the cordial reception given to this valuable practical work by electrical readers.

DIE TELEGRAPHIE OHNE DRAHT. By Adolf Prasch. Wien: A. Hartleben. 272 pages, 202 illustrations. Price, 5 marks.

Germany is intensely interested in wireless telegraphy; and this fact is apparent in the large amount of literature published in that country on the subject. Heretofore Dr. Braun and Prof. Slaby have been mainly responsible for such treatises, but each of these advocates the merits of a special system which is constructed in conformity to individual theoretical conclusions, so that to the time of the publication of the book under consideration no popular and unprejudiced work had appeared in Germany.

Dr. Prasch has written a concise history and treatise embodying the general principles of the art. The author does not confine himself to a review of the spark-gap and coherer system alone, but gives data concerning the conductivity, inductivity and electrostatic systems of wireless telegraphy as well. While the work, as a whole, contains little that is new in the technique of the art, it concludes with a *resumé* of the Marconi, Braun and Slaby-Arco apparatii in such form that they may be easily compared, and this is evidently just what the author intends giving his readers an opportunity of doing.

The litigation which has been so bitterly waged by the opposing Siemens & Halske and German General Electric companies and the pent-up interest in the validity of the Marconi claims, undoubtedly make the book a timely and welcome one, and, since it is written in a popular manner, it should have a large circulation. Mr. Prasch has been careful to cite his references employed in the preparation of the work and mentions ELECTRICAL WORLD AND ENGINEER as the authority on wireless telegraphy in the United States. The volume is well illustrated in outlines taken from many sources, including patent office drawings.

Directory of Electrical Societies, Etc.

AMERICAN ELECTROCHEMICAL SOCIETY, Secretary, C. J. Reed, Philadelphia, Pa. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa. Next meeting, Mount Washington Hotel, White Mountains, N. H., Sept. 9, 1902.

INDIANA ELECTRICAL ASSOCIATION, Secretary, Hal. C. Kimbrough, Muncie, Ind. Next meeting, Indianapolis, Sept. 17 and 18, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

THE OLD-TIME TELEGRAPHERS' AND HISTORICAL ASSOCIATION, Secretary, John Brandt, 195 Broadway, New York. Next meeting, Salt Lake City, Utah, Sept. 10, 11 and 12, 1902.

U. S. MILITARY TELEGRAPH CORPS, Secretary J. E. Pettit, Postal Telegraph Company, Chicago, Ill. Next meeting, Salt Lake City, Utah, Sept., 10, 11 and 12, 1902.

VERMONT ELECTRICAL ASSOCIATION, Secretary, C. C. Wells, Middlebury, Vt.

Multiple Wireless Telegraphy.

During the last week two operators of the De Forest Wireless Telegraph Company accomplished a feat, we are informed, which, while new in the annals of wireless telegraphy, is significant of the possibilities of the "responder" or automatic receiver in combination with the telephone. At the 17 State Street station, on the roof of the Chesebrough Building, New York City, two messages were received and read simultaneously by the two operators, listening in on two separate telephone receivers, attached to one and the same responder, and without any special attuning or syntonizing device in circuit. One message was from the Staten Island Station, and was sent quite rapidly—thirty words per minute—with a high-frequency spark (120 per second). The other was from some foreign station, evidently a Marconi installation. The speed was about ten words per minute, sent with a low-frequency interrupter. Mr. Horton concentrated his attention upon the Staten Island message, while Mr. Barnhart was able to pick out by their peculiar drumming sound the signals from the other station.

The result is no more remarkable than the fact that two conversations can be carried on simultaneously over the same telephone wire, if the two voices differ considerably in pitch and timbre. But the fact that without any tuning device this can be accomplished with one and the same responder would certainly seem to demonstrate the advantage of the telephone receiver over sounder or tape-recording device, and the greater immunity of such a system from atmospheric and foreign disturbances.

So far as has been published, two simultaneous messages is the record to-day for any tuned or syntonized system in its present development, and it is interesting to learn that, with two styles of interrupter, and sending speed sufficiently diversified, the same result can be accomplished by the human ear listening in a telephone connected with an automatic responder. Last week also, the De Forest operators established a new record as to speed in short-distance wireless transmission. A commercial message (not of selected words), 48 words in length, was transmitted and successfully read at the rate of 52 words per minute. This is far and away the fastest speed yet attained by the wireless telegraph; being five times as rapid, it is asserted, as is ordinarily attained by coherer systems.

Oil Switch With Circuit-Breaker Attached.

The accompanying illustrations show a type of oil switch which differs materially from the usual form. As will be seen, it is a combined switch and circuit-breaker and is adapted for installation on the ordinary switchboard. Fig. 1 shows the part of the switch on the front of the board and Fig. 2 the part which is on the rear.

The special features claimed for this switch are its simplicity in

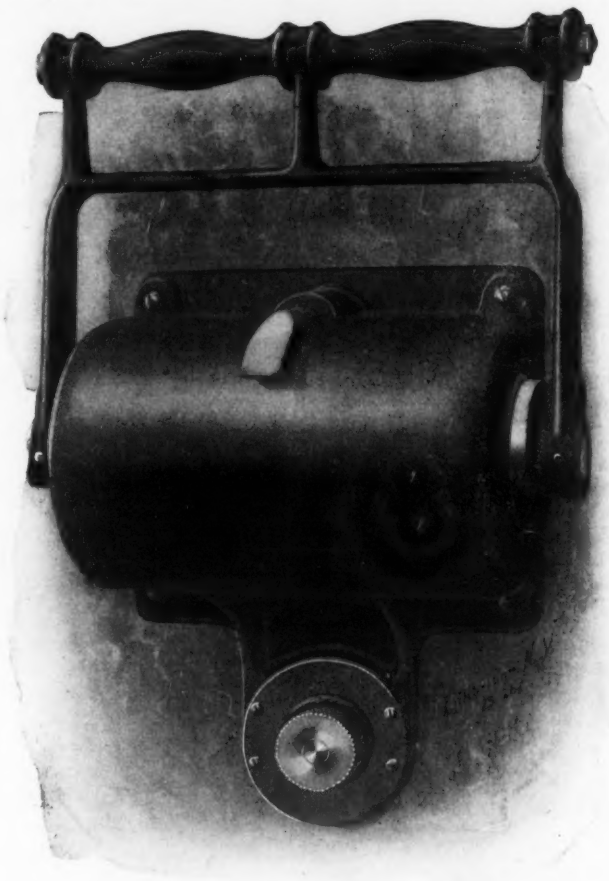


FIG. 1.—PART OF SWITCH ON FRONT OF BOARD.

construction and operation; the use of a special long break between the terminals and the blades; high insulation of working parts from the front of the board; a design which permits installation to suit a great variety of conditions; zinc tipped blades for high currents; and a separate tank for each pole, which is self-contained and removable, and affords free access to the working parts, even when the switch is carrying current.

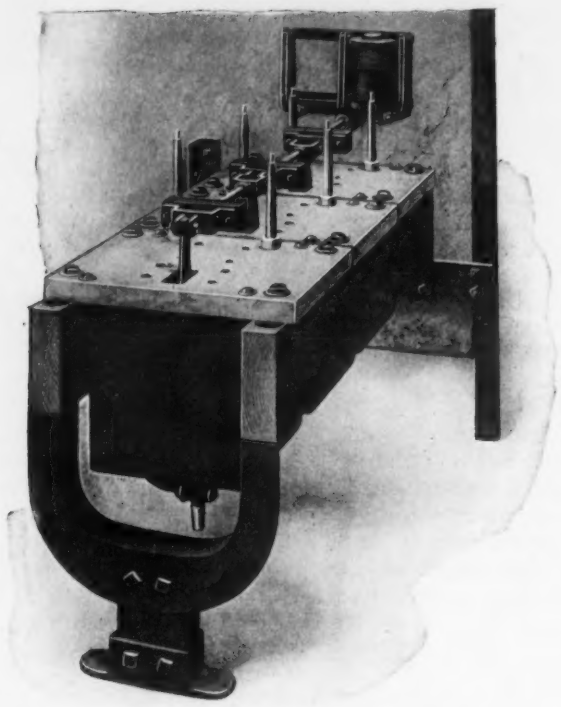


FIG. 2.—PART OF SWITCH AT REAR OF BOARD.

While a switch breaking in oil needs to have only a relatively small break, it is nevertheless wise to make the break distance as long as practicable in view of the fact that often such a switch controls the whole output of a station. Moreover, although the break is made in oil, zinc tips are desirable, as experience has demonstrated that a slight pitting of the blades leading in time to bad contacts, is inevitable. The zinc tips minimize this action and are easily removed and replaced by new ones.

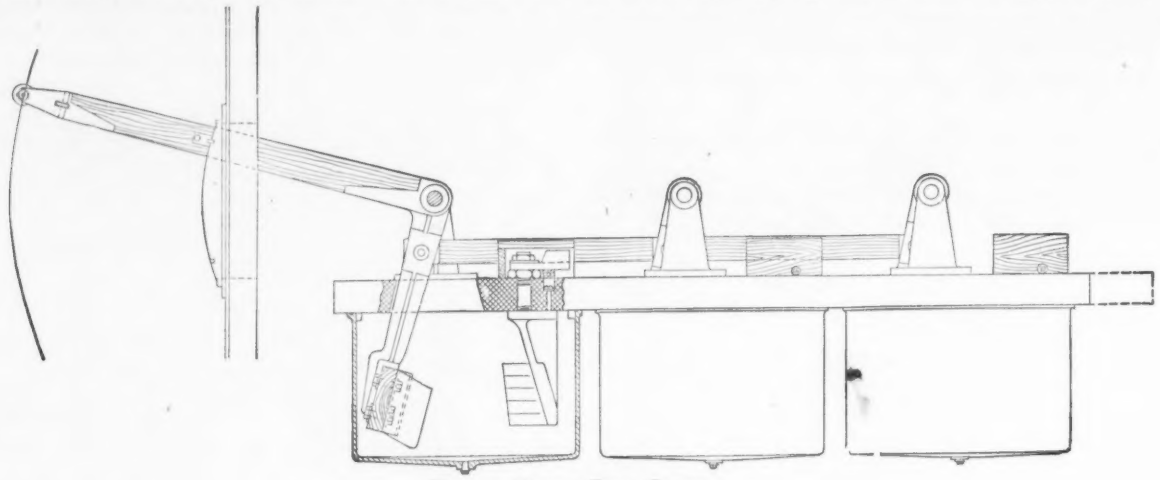


FIG. 3.—THREE-POLE SWITCH.

Immersing each pole in a separate procelain-lined compartment of the tank precludes leakage from pole to pole through the oil and, obviously, is a precaution against any short circuit inside the switch. The white porcelain lining facilitates the detection of the collection of any sediment.

Provision is made for drawing off and filling, without removing the tanks from place. By taking out four screws, which pass through the marble cover and without having to draw off the oil, the tank may be removed without in any way disturbing the switch and while it is carrying current. The line terminals are covered by cherry boxes, protecting against extraneous contact.

Fig. 3 shows a quick-break, three-pole switch with the tanks extended in a line back of the board. For narrow panels this construction is used. Where there is sufficient room the tanks are placed side by side along the board.

Fig. 4 shows a two-pole double-throw switch. This style is so mounted on a separate base that the entire switch may be removed from the board and be replaced, or another switch put in its place within a few minutes' time. The oil switches, single-pole, double-pole, three-pole, and four-pole, are made both single and double-throw for voltages from 4000 to 15,000 and currents from 1000 to 100 amperes respectively. The manufacturers do not advise the use of switches with four poles, being of the opinion that it is better practice to provide two double-pole switches.

The circuit-breaker attachment possesses the same characteristics as that on the slide switches of the same makers—the Stanley Electric Mfg. Company—and affords at minimum expense a combined switch and circuit-breaker claimed to possess all the advantages and many extra ones of two separate devices. It may be added to switches designed for as high as 200 amperes. By turning the disk, which is mounted directly under the operating handle (Fig. 1), the point at which the circuit-breaker attachment will operate may be changed at will.

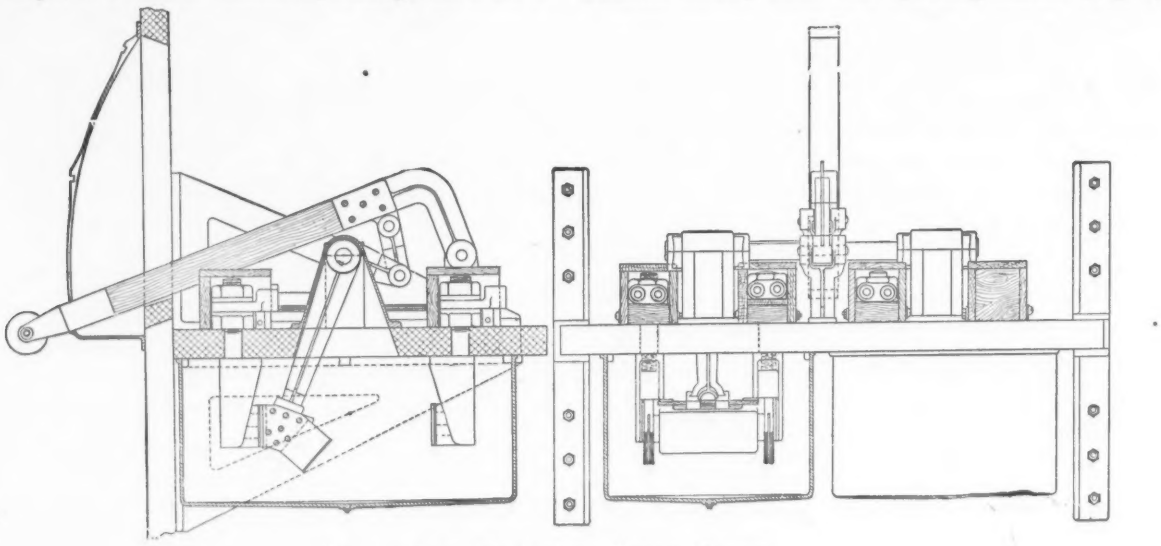
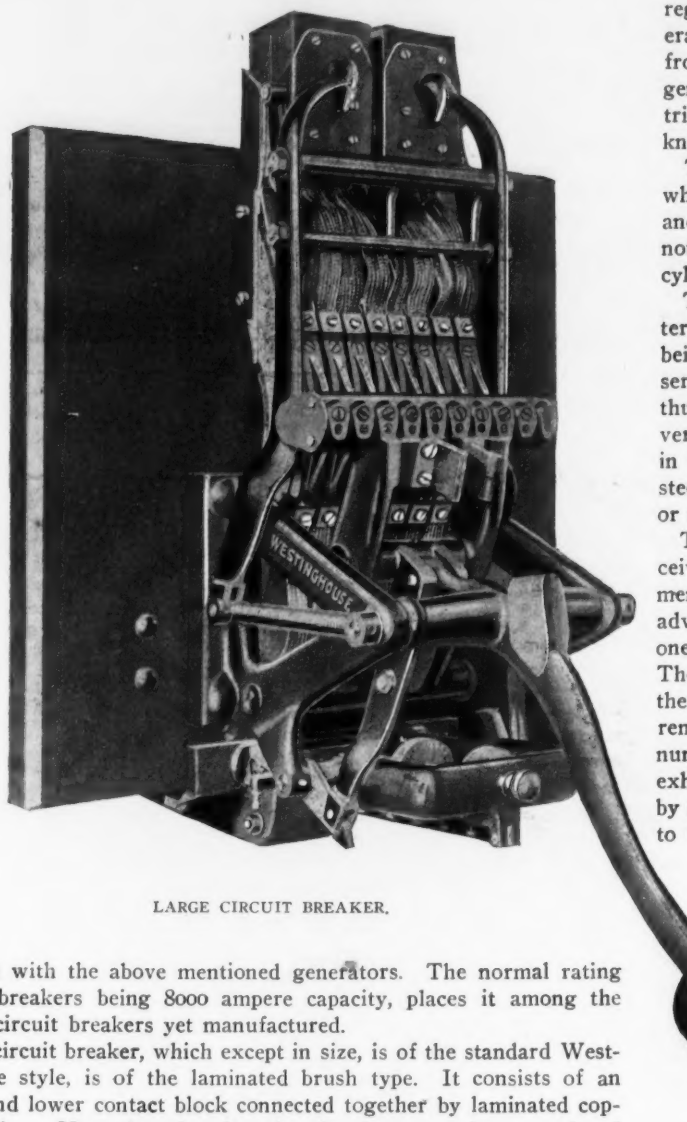


FIG. 4.—TWO-POLE, DOUBLE-THROW SWITCH.

Large Capacity Circuit Breaker.

For the direct-current generators recently constructed by the Westinghouse Electric & Mfg. Company, for the Boston Railway Company, it was necessary to build switchboard apparatus of unusual size, the most notable of which is an automatic circuit breaker. In the accompanying illustration is shown the type of circuit breaker



LARGE CIRCUIT BREAKER.

supplied with the above mentioned generators. The normal rating of the breakers being 8000 ampere capacity, places it among the largest circuit breakers yet manufactured.

This circuit breaker, which except in size, is of the standard Westinghouse style, is of the laminated brush type. It consists of an upper and lower contact block connected together by laminated copper brushes. Upon these brushes phosphor bronze springs are placed and upon these are the carbon contacts or arcing points. The brushes are held in contact with the contact blocks by means of a toggle mechanism locked by a trigger attached to the scale beam. The circuit breaker can be easily closed by hand and will open automatically throughout its entire range. (The 8000 ampere breaker has an adjustable range between the limits of 2,000 and 10,000 amperes.) To avoid any possibility of arcing at the laminated copper brushes, woven-copper cables are fastened from these brushes to the carbon arcing points. The automatic action is obtained in a very simple manner and without the use of coils by surrounding the lower contact block with a "U" shaped magnet of laminated iron and the magnetic circuit is completed by an armature of laminated iron attached to the scale beam.

In operation, the action of the circuit breaker is as follows: The passage of the circuit through the lower stud brushes and upper stud energizes the "U" shaped magnet which attracts the armature. This releases the trigger unlocking the toggle joint and copper spring brushes throw the breaker open. In breaking contact, the copper brushes leave the contact block first, aided by the pressure of the brushes which act with the releasing spring instead of against it, followed by the phosphor bronze spring. Then the carbon block or arcing point of the out-moving breaker armature separates from its carbon contacts and its circuit is broken. By this method the current is gradually shunted from the carrying brushes to the carbons, thus preventing any arcing from the metal parts of the breaker.

Gas Engine Generating Unit.

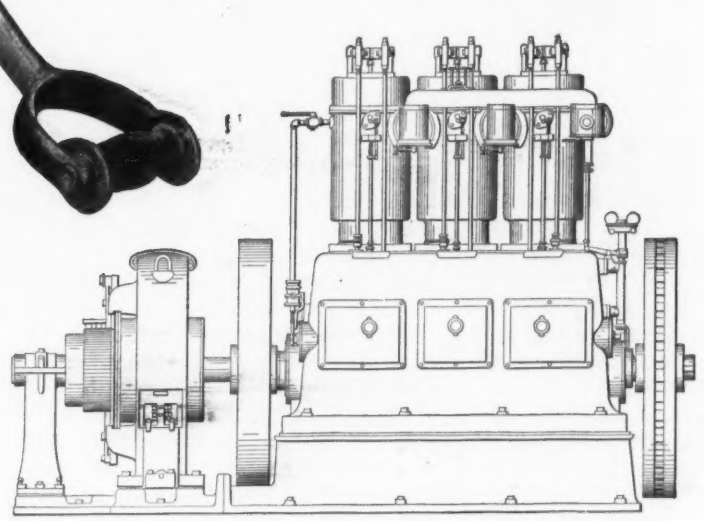
We illustrate herewith a 75-hp gas engine unit recently shipped by the MacKay Engineering Company to Japan. The unit consists of a 75-hp three-cylinder Walrath gas engine direct connected to a General Electric generator.

The Walrath gas engine, made by the Marinette Iron Works Manufacturing Company, Marinette, Wis., is especially designed for close regulation and is thus particularly adapted for running electric generators. During the past several years it has rapidly come to the front for this latter use, a long list of Walrath gas engine electrical generating units being in use at the present time in high-class electrical installations. As the type of generator illustrated is well known, a description of the unit will be confined to the gas engine.

This engine is the vertical crank-case type, a mechanical design which combines strength and simplicity with a handsome appearance. Among the advantages of the vertical type is that it does not require a massive foundation, has more durability as to wear of cylinders and pistons, and requires a minimum of floor space.

The engine is particularly noticeable for its simplicity. The intermediate shaft with its gearing and shaft is enclosed in a case, and being self-oiling, the wear and tear is reduced to a minimum. The serious objection to oil passing the piston and covering the igniter, thus stopping the engine, which is a common occurence with other vertical self-oiling types, has, it is claimed, been entirely overcome in this machine. The crank shaft is a solid forging of open hearth steel, without welds, and is fitted with main bearings easily removed or replaced without disturbing the shaft.

The cylinders fit into a bore on the top of the base made to receive them, it thus being impossible for them to get out of alignment. Being of the vertical type they are free to expand. A notable advantage of this method of mounting the cylinder is that should one cylinder become damaged it can be readily removed and replaced. The valves are placed within the cylinder head in cages, and as all the piping is connected to the cylinder proper, the head can be readily removed. The valves, which are of the poppet type, are two in number, one for the inlet or explosive mixture and the other for the exhaust. The pistons are of the open trunk type and are kept tight by six snap rings of cast-iron. Balance weights are fastened directly to the crank shaft. While this is more expensive than to put the



THREE-CYLINDER GAS ENGINE.

balance weights on the flywheel, the manufacturers consider the extra expense more than justified by the better results.

The igniter consists of a casting containing two electrodes, one of which is stationary and insulated from the main body of the casting. The second electrode is movable and is operated by a cam which causes it to make and break contact with the insulated electrode. The contact points are of special metal adapted to withstand great heat.

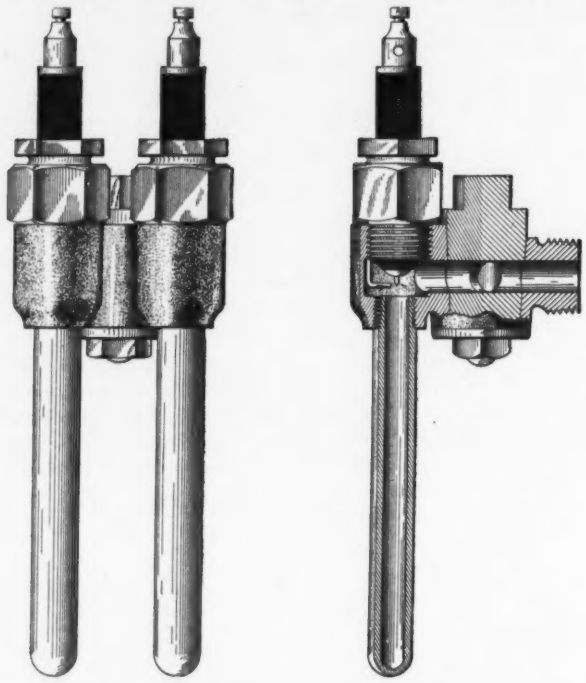
The governor is of the fly-ball type driven by means of beveled gear. It is made to operate a piston valve, which regulates the exact amount of explosive mixture required for each impulse to maintain a steady speed under all conditions and variations of load. This method of governing gives an impulse every two-thirds of a revolu-

tion in the three-cylinder type, irrespective of the load being driven. The sensitiveness of this arrangement is evident from the fact that scarcely two per cent variation in speed can be discerned in throwing on or off full or part load.

The Walrath engine is adapted to run on natural or artificial gas or gasoline. A brake hp-hour is produced on approximately 11,000 to 12,000 B. T. U., corresponding with natural gas to a brake hp-hour for 10 cubic feet of gas, the quantity being greater, of course, with illuminating or producer gas. The amount of gasoline per brake hp-hour will vary from one-tenth to one eighth of a gallon, the gasoline varying from 70 to 76 degs.

The Cotton Duplex Igniter.

Since the use of the gas engine has so largely increased through its application to many different purposes for individual power, there have been a number of devices produced with a view to making more certain and continuous the operation of explosive motors. A recent interesting improved type is the Cotton duplex igniter, which is illustrated herewith. This igniter consists of a T-shaped casting, provided with a pair of spark-plug receptacles; a three-way valve and a



REAR AND SIDE SECTIONAL VIEWS, DUPLEX IGNITER.

nipple. A compression tube enters each plug receptacle. In the application of this device the nipple is screwed into any canal leading to the compression chamber of the engine cylinder. The nipple is made to fit a ½-inch pipe thread, or smaller to order. On engines fitted with hot tube ignition it is very convenient to screw out the tube and insert the igniter in its place. In the operation the gas is compressed through the nipple to one of the plugs when it is ignited at the desired period; the expansion cycle of the engine then taking place. On the return or cycle of exhaustion the gases in the igniter are exhausted to substantially that pressure of the engine, or near atmospheric pressure, leaving a certain quantity of dead gas which is forced into the compression tube on the next compression cycle to such an extent that the combustible gas passes through and fills the plug receptacle with absolute surety of ignition under a variable compression. The advantages attained through this device are self-evident. Troubles caused through deposits of carbon or other electrical conducting material on the insulation of the plugs are entirely obliterated through gaseous friction, the insulation and electrodes being always in a polished condition. It is evident that the operation of the engine can be continued indefinitely, for if any missing of ignition through defects in the active plug is detected, the current can be switched to the other plug, while at the same time the valve is turned. The defective plug can then be removed and a new one inserted.

The Duplex Igniter is manufactured and exclusively for sale by the Automobile Equipment Company, at 21 Quincy Street, Chicago. It will be sold separate without other gas engine devices, but the company intend to push the Hydra double battery and jump spark coils in connection with this device. The Hydra is the well known German dry battery just put on the American market, for which the company have secured a general agency.

Insulator for High-Voltage Transmission.

It is quite natural that the progressive rise in transmission line voltage should have introduced insulation problems of no mean proportions in long-distance power transmission engineering, but, perhaps, few realize the consequent revolution that has been worked in types of pole-line insulators. As an illustration of this we show

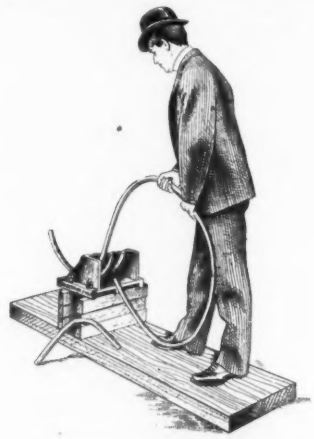
HIGH-VOLTAGE TRANSMISSION INSULATOR.

herewith a view of one of the latest types of these insulators alongside a standard glass telegraph insulator. The former is 14 inches across the hood, 11½ inches high and weighs 18 pounds. The manufacturer, Fred. M. Locke, of Victor, informs us that the insulator is made of a special mixture of clay known only to himself, and that it will withstand a test voltage of 160,000 and a working voltage of 80,000.

A New Bending Machine.

The accompanying illustration shows a machine for bending electric conduit to any desired curve. The machine weighs about 100 pounds, and is adapted for five commercial sizes of such conduit, namely, ½, ¾, 1, 1¼ and 1½ inches.

The curved surfaces of the machine are so designed as to prevent as far as practicable the bulging of the conduit at the sides during



BENDING MACHINE.

curvature. In making long or short elbows a length of the conduit is entered in the hole of the proper size and then lifted up with one stroke for a short curve, or with several short strokes for a long curve of larger radius. In making long curves the conduit is progressively pushed forward a little at each stroke. A 3-inch extension of the base acts as a heel to bear down on it in making offsets or straightening curves. The manufacturers of this machine are Wm. W. Benson & Co., 1001 Chestnut Street, Philadelphia, Pa.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 4½ per cent. for 60 to 90 days, and 4⅝ to 5 per cent. for four, five and six months; it was offered with some freedom. The stock market was slightly reactionary, mainly on account of the large gold shipments and their prospective continuance. Public interest in speculation, however, fell off sharply. Industrials were neglected, the steel stocks being heavy on the delay in the bond litigation. At the latter part of the week industrials and traction stocks were a little more active, there being renewed pool support in both Brooklyn Rapid Transit and Manhattan. Brooklyn Rapid Transit reached 70⅞ during the week, the lowest point being 67⅞, and the closing, 69¼. The transactions were heavy, the number of shares sold being 96,850. General Electric closed at 185⅛ on sales of 5,400 shares, being a net loss of 2¼ points. The extreme quotations were 181¾ and 186. Metropolitan Street Railway closed at 149¾, which was ¾ of a point below the highest quotation reached, and ¾ of a point higher than the lowest, the net loss being ¼ of a point. The sales were 5,900 shares. Western Union Telegraph made a net gain of 1¼ points, closing at 87½ on sales of 41,100 shares. The prices ranged between 85, the lowest, and 88, the highest, the closing price representing a net gain of 1¼ points. Westinghouse closed at 210½, a net gain of ½ point. This was the lowest price of the week, the highest being 214. Following are the closing quotations of August 5:

NEW YORK.

	July 29.	Aug. 5.		July 29.	Aug. 5.
American Tel. & Cable.	—	93⅞	Hudson River Tel.	—	—
American Tel. & Tel.	164	164	Metropolitan St. Ry.	149⅜	149
American Dist. Tel.	—	—	N. E. Elec. Veh. Trns.	—	10½
Brooklyn Rapid Transit.	68¼	69¼	N. Y. & N. J. Tel.	—	—
Commercial Cable	—	—	N. Y. E. V. T. Co.	—	—
Electric Boat	30	25	Tel. & Tel. Co. Am.	—	—
Electric Boat pfd.	50	50*	Western Union Tel.	86⅛	89
Electric Lead Reduc'n.	—	2½	West. E. & M. Co.	—	—
Electric Vehicle	7	7⅛	West. E. M. Co. pfd.	210½	—
Electric Vehicle pfd.	—	14½			
General Electric	184½	185¼			

BOSTON.

	July 29.	Aug. 5.		July 29.	Aug. 5.
American Tel. & Tel.	164	163¾	Mexican Telephone	—	2¼
Cumberland Telephone	125	—	New Eng. Telephone	144	142
Edison Elec. Illum.	280	280	Westinghouse Elec.	—	—
Erie Telephone	—	—	Westinghouse Elec. pfd.	—	—
Western Tel. & Tel.	—	—			
Western Tel. & Tel. pfd.	—	—			

PHILADELPHIA.

	July 29.	Aug. 5.		July 29.	Aug. 5.
American Railways	47	47¾	Phila Traction	99⅞	99¾
Elec. Storage Battery	92	—	Phila. Electric	5 9/16	5⅝
Elec. Storage Bat'y pfd.	—	—	Pa. Elec. Vehicle	—	—
Elec. Co. of America	8⅞	8⅞	Pa. Elec. Vehicle pfd.	—	—

CHICAGO.

	July 29.	Aug. 5.		July 29.	Aug. 5.
Central Union Tel.	—	—	National Carbon pfd.	107½	102½
Chicago Edison	177	—	Northwest Elev. com.	37	—
Chicago City Ry.	220	210	Union Traction	15¼	—
Chicago Tel. Co.	127¼	—	Union Traction pfd.	—	47
National Carbon	—	30			

* Asked.

GERMAN ELECTRICAL SECURITIES.—A special cable dispatch from Berlin, of August 3, says: With the exception of the shares of a few domestic railroads the Bourse was pronouncedly weak along the line last week. All industrial securities were sluggish, and declines were universal. This department was under the influence of the report of the Schuckert Electrical Company, of Nuremberg. It was also influenced by the reduction of the dividend of the Bochum Cast Steel Company to 7 per cent., as against 13⅓ per cent. last year, and further reports of the coal trade, which represented conditions to be unsatisfactory. Iron and coal shares declined during the week, but not to the extent of the week previous, and Friday and yesterday brought a partial recovery in prices. Shares of other electrical companies fell in sympathy with those of the Schuckert Company, the latter losing 9½ points. The *Frankfurter Zeitung*, commenting upon the report of the Schuckert Company, says it shows the evil effects of the system which prevailed with electrical manufacturing companies during the boom of unduly pushing the organization of traction and lighting plants in order to make work for themselves, and also taking shares in such plants.

ROCHESTER GAS AND ELECTRIC.—N. W. Harris & Co. offer to investors at 101 and interest, $650,000 first mortgage forty-year 4½ per cent. gold bonds of the Municipal Gas and Electric Company of Rochester, principal and interest guaranteed by the Rochester Gas and Electric Company, and are optional on any interest payment date on and after April 1, 1912, at 102½ and interest. The Rochester Gas and Electric Company has acquired all the property franchises, etc., of the Municipal Gas and Electric Company, and has assumed and guaranteed the payment of the principal and interest of its bonds. For several years the company has paid dividends at the rate of 6 per cent. on both common and preferred shares, and according to local quotations on the stocks, the market value of the equity is over $4,000,000. The Rochester Gas and Electric Company now controls the entire gas and electric business of Rochester, operating under franchises unlimited as to time. Within the city limits of Rochester the Genesee River has a fall of about 260 feet, and about 90 per cent. of this water power is owned by the Rochester Gas and Electric Company.

DIVIDENDS.—The directors of the National Carbon Company have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable August 15. The Louisville Gas Company has declared the usual semi-annual dividend of 2½ per cent., payable to stockholders of record July 7. The old officers, including President Snead, have been re-elected. Nothing has been heard for some time of the proposition to bup up the two gas and the two electric companies for merger with the street railway, but the securities of all those corporations are very strong. Directors of Electric Company of America have declared the regular semi-annual dividend of 25 cents per share, payable August 18, out of the net earnings for the six months ending June 30, 1902, being at the rate of 6⅔ per cent. per annum. The directors of the Westinghouse Electric & Manufacturing Co. have declared the regular quarterly dividend of 1¾ per cent. on the assenting stock, payable August 15.

GERMAN-AMERICAN CABLE.—The German Atlantic Telegraph Company in Cologne is issuing 4 per cent. debentures to the amount of 20,000,000 marks, to provide for the cost of laying a second cable between Germany and the United States, the present cable having already proved inadequate for the increasing traffic. A new agreement has, at the same time, been concluded between the company and the Imperial Postal Administration, whereby the company's privilege is extended until 1945, and the following stipulations are made: "Provided that by 1904 the second cable is ready, as far as the Azores, the imperial exchequer will pay the company for the year 1904 a fixed compensation of 750,000 marks, and provided that the whole cable is ready in January, 1905, the company will receive from the exchequer a yearly subsidy of 1,710,000 marks until 1944."

NEW ORLEANS TROLLEYS.—The purchase of the St. Charles Street Railroad in New Orleans has caused great activity in the securities of the New Orleans Railways, the consolidation of the gas, electric and street railway properties. The St. Charles was the last one of these properties to be purchased by the Pearson syndicate. It is nineteen miles long and has valuable franchises, and was bought for $210 a share, the market price of the shares being 201. It has a capitalization of $1,000,000 of common stock and $15,000 of preferred, and no bonds. Mr. Pearson will pay $50 down for each share held by the 350 stockholders and the remainder in 4 per cent. bonds.

EVANSTON LIGHTING SALE.—A telegram from Chicago, of August 1, says: Mr. Samuel Insull has purchased the Evanston Electric Illuminating Company. This concern has been owned for a number of years by the Westinghouse Electric Company. It supplies Evanston with electric light. With this purchase Mr. Insull becomes the owner of all the electric lighting plants in the important cities along the lake shore from the city limits to the Wisconsin State line, a distance of between 15 and 20 miles. Mr. Insull is president of the Chicago Edison Company, but that corporation has no present interest in the lake shore electric plants which he has purchased. Eventually, it is presumed, these various concerns will be under one organization.

LOS ANGELES EDISON.—N. W. Harris & Co. has closed a contract for the purchase of a block of about $3,000,000 of the bonds of the Edison Electric Company of Los Angeles, California. These bonds will probably be placed on the market early in September.

ST. JOSEPH CONSOLIDATION.—The St. Joseph, Mo., Railway, Light, Heat & Power Co. has passed from the hands of the Harriman syndicate to E. W. Clark & Co. and J. & W. Seligman.

AMERICAN UNION ELECTRIC.—Last week we noted the consolidation of the Union Railway Power and Electrical Company, the Morris Electric Company, Fountain Manufacturing Company, and five other established railway equipment and electrical companies under the name of the American Union Electric Company, with a capital of $7,000,000, of which $5,000,000 is outstanding. The company, which has an extensive plant at East Orange, is building a large addition to its plant. The business consists in the manufacture of rail bonds, trolley wheels, fare registers, trucks and sweepers, headlights, car trimmings and electric devices, such as panel boards, switches and switchboards, junction boxes, etc., and brass castings. The management of the company is under the direction of Elmer P. Morris, S. M. Young, E. P. Ewing and J. Fountain, with New York headquarters at 15 Cortlandt Street.

SPRINGFIELD, ILL., TROLLEYS.—The securities of the Springfield Consolidated Street Railway have been strong upon the report that E. W. Clark & Co. are trying to purchase the property, and the electric and lighting plants in Springfield, Ill., in the interest of consolidation. The stock is controlled by four or five men, and they are not willing to sell except at a good price. The road is said to be showing earnings now at the rate of $200,000 a year, against $142,000 last year. It has a capitalization of $750,000 in 5 per cent. bonds and $750,000 in stock.

Commercial Intelligence.

THE WEEK IN TRADE.—Quietness prevailed in trade, while attention was concentrated on crop and industrial development. Generally lower prices for farm products point to the crops being large, though the passing of the July period of manipulation is a weakening influence. In industrial affairs the outlook is satisfactory, says *Bradstreet's*. The iron and steel situation is still a strong one, but isolated examples of weakness show themselves. The coal strike continues, but it is looked upon to be in its last stages, though the final ending may be long drawn out. The railway situation is one of the best in years, and the outlook as to tonnage is a flattering one, marred only by the prospect of car shortages later on reducing or curtailing industrial operations. Fiscal year earnings returns are exceptionally good and it is probable that. taken as a whole, railway earnings for the first half will exceed those of the same period last year, despite the strike reducing anthracite coal miners' earnings. Hardware is active, especially for building; the 1901 record of building will, it is stated, be surpassed this year. Business failures, according to *Bradstreet's*, number 168, as against 178 the week previous, and 160 the same week last year. The copper market is unchanged, the demand being slight and no increase in export business being reported. Quotations are 11.75 to 12c. for Lake, 11.75 to 11.90 for electrolytic, and 11.65 to 11.75 for castings.

STORAGE BATTERY INSTALLATIONS.—Among the most recent contracts closed by the Electric Storage Battery Company, of Philadelphia, for "Chloride" accumulators in railway service are the following: Providence and Danielson R. R., Providence, R. I., 107 kw; Mahoning Valley Railway Company, Youngstown, Ohio, 351 kw; Kansas City-Leavenworth, Wolcott, Kan., 160 kw; Detroit United Railway, Detroit, Mich., 172 kw; Connecticut Railway and Lighting Company, Derby, Conn., 175 kw; Los Angeles and Pacific Railway Company, Los Angeles, Cal., 126 kw; Harrisburg Traction Company, Harrisburg, Pa., 264 kw; Eastern Ohio Traction Company, Gates Mill, 259 kw; East Bangor, Portland and Delaware River Railway Company, East Bangor, Pa., 87 kw; Greenville and Turner's Falls Street Railway Company, Cheapside, Mass., 83 kw; Capital Traction Company, Washington, D. C., 173 kw; Consolidated Railway Traction and Power Company, 119 kw; York County Traction Company, Red Lion, Pa., 90 kw; Orange and Passaic Railroad Company, Orange, N. J., 209 kw; Milwaukee Electric Railway and Lighting Company, 2 batteries aggregating 1,700 kw; Portland and Brunswick Street Railway Company, Brunswick, Me., 72 kw; Ottawa Electric Railway Company, Ottawa, Ontario, 599 kw; Danville, Paxton and Northern Railway Company, Georgetown, Ill., 65 kw. An increase of 50 per cent. has also been made in the Peekskill Light and Railway Company's battery, which originally consisted of 87 kw. Other contracts recently closed embrace a battery of 8,000 amperes at 120 volts, for the Edison Electric Illuminating Company, of Brooklyn; a residential plant for C. Ledyard Blair, Far Hill, N. J.; batteries for the Wolvin Building, Duluth, Minn.; John D. Rockefeller for West Side Neighborhood House, New York; Merck & Company factory at Rahway, N. J.; John R. Sherman, residential plant, Port Henry, N. Y.; J. Hurst Purnell, office building, Baltimore; Hanover National Bank, New York; New York Stock Exchange; J. Samuels & Brother, of Providence, R. I.

ARMSTRONG-ORLING APPARATUS. — The *Westminster Gazette*, of London, announces that a company has been formed with a nominal capital of £175,000, privately subscribed, for the purpose of operating the Armstrong-Orling system of wireless telegraphy. The paper says it is informed that this company will begin operations on a large scale almost immediately. Two factories will be erected, one in Buckinghamshire, England, and one in France, at places which have already been selected. Everything in connection with the new scheme, down to an illustrated catalogue and price-list, is ready. According to advance proofs of the price-list, the charge for transmitters for sending Morse signals short distances will be £10, and for long distances, £15, in addition to a royalty of £1 per year. A complete telephone outfit for short distances will cost £4 a year, and a royalty of £1. This system has already been noted in these pages.

THE CROCKER-WHEELER COMPANY, of Ampere, N. J., is finding an ever-increasing demand for its various lines of direct-current machinery, as is evidenced by the necessity for large increases of floor space. A new building, now half-way to the roof, will nearly double the present capacity, while clearing out many small machines in the main shop will permit of the placing of new and heavier machinery to accommodate larger sized generators and more rapid work on large orders for the smaller standard machines. The new building is of brick, slow-burning mill construction, three stories in height, and intended for the winding departments and light machine tools. A portion of the basement space will be used for the experimental laboratories, whence emanate the changes in design that maintain the reputation of Crocker-Wheeler apparatus.

PAWLING & HARNISCHFEGER, Milwaukee, Wis., makers of electric cranes and hoists, have just acquired the Gardiner-Campbell Company property, adjoining their works. It is 200 x 150 feet, and the three story building is being entirely remodeled to supply additional machine shop facilities, also to provide extra pattern storage. The foundry is being changed over, and an addition made thereto, and in the entire building will be placed a modern foundry equipment. Among the improvements will be two P. & H. electric traveling cranes. The present power plant is being much enlarged, and new boilers, engines and another generator will be provided. It is stated that these improvements will considerably shorten the time required to complete a crane or hoist. Various supplies and details will be needed.

ELECTRIC LOCOMOTIVES ORDERED.—Contracts have been awarded by the Baltimore and Ohio Railroad Company to the General Electric Co. for the two largest electric locomotives in the world. Each machine will weigh 150 tons, and be capable of drawing 1,500 tons of freight up the heavy grades of the belt-line tunnel, which runs nearly two miles under the city. Passenger trains have been drawn through the tunnel by electricity since it was opened in 1895, but the motors now in use are not capable of pulling the heavy freight trains. The motors will be designed to haul twice the load the steam locomotives at present pull through the tunnel.

ELECTRICAL EXPORTS.—According to the preliminary figures of the Bureau of Statistics for the fiscal year lately closed, exports of electrical machinery fell off $432,969, and instruments of all kinds, including electrical, $1,071,755. These declines appear to be wholly attributable to the production of American apparatus abroad in new factories. The total of manufactured exports for 1901-2 is $412,155,066, or about $20,500,000 less than in the year preceding. The grand total of exports is $1,460,462,806, or $90,000,000 more than in the previous year.

THE STERLING ELECTRIC COMPANY, of La Fayette, Ind., are very active on common battery installations now building or in prospect. They report having secured in the last week contracts for complete exchange equipment and telephones at the following points: Newark, Ohio, 3,000 capacity; Davenport, Ia., 4,000 capacity; Rock Island, Ill., 4,000 capacity; Moline, Ill., 3,000 capacity; Paris, Ky., 3,000 capacity.

THE HELIOS-UPTON COMPANY has secured an order for a 3,000-ampere battery from the Grand Rapids Edison Company, of Grand Rapids, Mich. This is the second large contract for storage batteries secured from Edison central stations by this company, the other contract being for a large battery installed by the Edison Company, of Kansas City, Missouri.

BALL ENGINES.—The Ball Engine Company, Erie, Pa., has supplied the engines for an electric plant for power and light being installed by the National Color Type Company, Chicago. The Ball Company is also supplying to the Jos. Dixon Crucible Company, Jersey City, N. J., an engine for direct connection to a 100-kw generator.

THE LUNKENHEIMER COMPANY has recently purchased a large number of Westinghouse induction motors, for the equipment of its new works at Cincinnati, Ohio.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended August 2: Argentine Republic—33 pkgs. material, $722; 20 pkgs. machinery, $7,170. Amsterdam—1 pkg. machinery, $110. Antwerp—43 pkgs. material, $1,946; 13 pkgs. machinery, $1,994. Brazil—112 pkgs. material, $4,536; 57 pkgs. machinery, $39,332. British East Indies—1 pkg. machinery, $120; 16 pkgs. material, $1,025. British Possessions in Africa—6 pkgs. machinery, $462. Bremen—19 pkgs. material, $1,217. Brussels—10 pkgs. material, $220. British Guiana—11 pkgs. material, $384. British Australia—2 pkgs. material, $60; 29 pkgs. machinery, $1,571. British West Indies—58 pkgs. material, $689. Cuba—94 pkgs. material, $1,359. Christiana—1 pkg. machinery, $40. Chili—2 pkgs. material, $130. Central America—9 pkgs. material, $279. China—1 pkg. material, $93. Copenhagen—4 pkgs. machinery, $1,519. Dutch East Indies—1 pkg. material, $30. Ecuador—3 pkgs. material, $516. Frankfort—10 pkgs. machinery, $390. Glasgow—50 pkgs. machinery, $567; 15 pkgs. material, $1,335. Genoa—14 pkgs. machinery, $1,000. Havre—46 pkgs. material, $1,515; 22 pkgs. machinery, $875. Hamburg—14 pkgs. machinery, $1,320; 48 pkgs. material, $1,340. Japan—1 pkg. machinery, $92; 95 pkgs. material, $3,196. Liverpool—307 pkgs. machinery, $56,947; 40 pkgs. material, $1,378. London—187 pkgs. machinery, $5,663; 178 pkgs. material, $9,018. Mexico—88 pkgs. material, $1,799. Moscow—5 pkgs. machinery, $390. Manchester—412 pkgs. machinery, $36,417; 8 pkgs. material, $572. New Zealand—50 pkgs. machinery, $7,840; 137 pkgs. material, $6,963. Philippines—19 pkgs. material, $1,370. Peru—60 pkgs. material, $2,100; 1 pkg. machinery, $36. Rotterdam—4 pkgs. machinery, $200. Riga—5 pkgs. material, $92. Stockholm—1 pkg. material, $15. Sheffield—2 pkgs. machinery, $700. Siam—35 pkgs. material, $2,622. San Domingo—5 pkgs. material $75. Southampton—6 pkgs. material, $205. U. S. Colombia—2 pkgs. material, $13. Vienna—2 pkgs. material, $50. Venezuela—5 pkgs. material, $161.

THE BUFFALO FORGE COMPANY, Buffalo, N. Y., notes a few of the orders recently received through its different branch houses: Two 70-inch steel plate steam fans, for heating and ventilating, direct connected to two Buffalo Forge engines, and one 130-inch, ¾-housing standard steel plate pulley fan, for mechanical draft, are to be shipped to Copenhagen, Denmark. One induced draft plant and one 23-hp engine for electric light plant in Dutch Guiana, S. A. Five engines of 45 hp each, for driving generators, and one 38-hp engine for a pumping equipment, to be installed in a sugar factory, now being built near Manzanillo, on the south side of Cuba. One 20-hp engine, to be shipped to Gustemunde, Germany. One 15-hp, double vertical, single acting engine, to Gothenburg, Sweden. One 60-inch standard steel-plate fan, for ventilation, to a point near Glasgow, Scotland. One 140-inch steel plate fan with heaters, complete, for heating and ventilation, Barrow-in-Furness, England. One standard 80-inch fan and heater, complete, and one 90-inch pulley fan for ventilation, and one 30-hp horizontal engine, to London, England. One 120-inch fan and six 60-inch fans, to Manchester, England. One 80-inch standard steel plate fan, for mechanical draft, to Victoria, B. C. One 110-inch steel plate pulley fan, direct connected to a cylinder above-shaft engine, for mechanical draft, to Halifax, N. S. One 70-inch fan and one 100-inch fan, for heating and ventilating purposes, to Portland, Ore. One standard 40-inch steel plate fan, to College Station, Tex. One 100-inch steel plate fan, direct connected to a single vertical engine, to San Francisco, Cal. Two special 60-inch steel plate fans, to New Orleans, La. One 25-hp horizontal engine, to Gretna, La.

SOME HARRISBURG ENGINE ORDERS.—The Harrisburg Foundry and Machine Works, New York, offices 203 Broadway, have taken a contract from the New York, New Haven and Hartford Railroad Company for a 300-hp Ideal engine, also a 105-hp, one for installation in the Newport, R. I., shops. The first-mentioned engine will be double direct connected to two 100-kw generators, built by the General Electric Company. The smaller engine will be double direct connected to 35-kw General Electric generators. The equipment will serve for light and power purposes. The New York Central Railroad Company's new shops, at Oakgrove, Pa., are to be furnished with two 225 Harrisburg standard, tandem-compound engines, each to be direct connected to 150-kw General Electric generators. The outfit will also be for both light and power. The Hebrew Orphan Asylum, now under construction at 136th Street and Amsterdam Avenue, New York, is to be equipped with one 120-hp standard engine and a 75-hp machine for lighting use. The Harrisburg people have also secured an order for a 75-hp standard engine for the West Point Military Academy. The engine will be direct connected to a 50-kw Westinghouse lighting generator.

LARGE ELECTRIC SHIPBUILING CRANE.—The Brown Hoisting Machinery Company, of Cleveland, Ohio, through its New York offices, of which Mr. W. A. Stadelman is manager, has just been awarded an interesting contract by the United States Government for a large electric cantilever crane, to be installed in the New York Navy Yard, Brooklyn. The equipment will be erected in the building slip where one of the three large battleships, for which Congress recently made appropriation, is to be built. The crane, it is said, will be one of the largest electrically operated shipbuilding outfits of its description ever constructed. The trestle, a Brown hoist steel one, will be 500 feet in length and 60 feet in height. The crane will have a capacity for lifting 30,000 pounds 60 feet either side of the center, and 10,000 pounds 95 feet. The equipment is to be driven by a motor of 80 hp (nominal), which will be supplied by the Elwell-Parker Electric Company, of Cleveland, Ohio. The crane will be ready to begin working in nine months. The value of the contract is said to be $110,000.

TROLLEY POLES FOR SYDNEY.—The National Tube Company, through the American agents of the New South Wales Government, R. W. Cameron & Company, 33 South William Street, New York, has secured a contract for a number of trolley poles, which will be forwarded to Australia for use on the Sydney city and suburban electric traction system. This road is being constructed with American material, the General Electric Company having secured the contract for some $800,000 worth of power-house equipment. The capacity of the plant will be practically doubled shortly, which will result in an expenditure of fully $500,000. The boilers in the initial plant are of Babcock & Wilcox build. The engines are of Allis manufacture. The present capacity of the Sydney central power station is somewhat over 6,000 horse-power. It will be increased to 11,000 hp. The poles will be manufactured at the Morris-Tasker Works, Philadelphia.

CATALOGUES WANTED.—Mr. W. J.. Martin, of the electrical department of the George A. Fuller Company, 137 Broadway, New York City, wishes to receive electrical catalogues of all kinds for office files and reference, and for immediate ordering, etc. This concern is the largest in the world as a builder and operator of real estate, and its electrical necessities are of a very large and important kind in every class of apparatus. As many of our readers are aware, it has just absorbed, in a new and larger company, several of the big New York real estate corporations, making its business of a greater magnitude than ever. Every electrical manufacturer will do well to put his catalogues in the hands of the company's electrical department as requested.

CAR TRUCKS AND EQUIPMENTS FOR SOUTH AFRICA.—The British electrical engineering and contracting firm of Macartney, McElroy & Company, whose New York offices are in the Havemeyer Building, has placed a contract for 10 trucks with the J. G. Brill Company, of Philadelphia, and a similar number of 58-type motor equipments with the General Electric Company, for 10 cars, the bodies of which will be manufactured in England for an extension to the Durban municipal electric traction system, South Africa.

THE KELLOGG SWITCHBOARD & SUPPLY CO. has just closed a contract with the Keystone Telephone Co., Philadelphia, Pa., for a switchboard for its Fourth District Exchange of 7,200 lines ultimate capacity, and 3,420 lines present equipment. Included in this contract is all necessary power apparatus, distributing frames, sneak current and lightning arresters. This exchange will be complete in all its details, and embody the latest improvements.

BIG SOUTH AFRICAN TRACTION PROJECT.—The Anglo-African house of Wernher, Beit & Co., which financed the construction, withAmerican equipment, of the City of Mexico and the Lisbon, Portugal, electric traction systems, is reported to be largely interested in the project to build extensive trolley lines in the city of Johannesburg, South Africa. It is anticipated that the bulk of the material, equipment, etc., will be purchased in America.

A 6,000-HORSE-POWER POWER PLANT is to be erected by Nelson Morris & Company, the Chicago meat packers, for the purposes of furnishing light and power. Contracts are being let through Purchasing Agent Grassell. Babcock & Wilcox will furnish the boilers—12 batteries of 500-hp each. John A Mead & Company, of 11 Broadway, are to supply the coal and ash handling machinery, capable of handling 45 tons per hour.

WESTINGHOUSE GAS ENGINES. The Atlantic Refining Company has placed a contract with Westinghouse, Church, Kerr & Company for two 500-hp Westinghouse, horizontal, double-crank gas engines, for direct connection to 325-kw alternating-current generators, built by the General Electric Company. The equipment is to be utilized for general power purposes in the company's plant at Point Breeze, Philadelphia.

MR. G. M. GEST, the conduit contractor, has been awarded the contract for the additions to the subway system of the Edison Electric Illuminating Company, of Brooklyn.

General News.

THE TELEPHONE.

BIRMINGHAM, ALA.—The annual meeting of the stockholders of the People's Home Telephone Company has been held. A dividend of two per cent. on the capital stock of $200,000 was declared. The officers are H. H. Stambaugh, president; Henry B. Gray, vice-president; W. H. Hassinger, secretary and A. F. Adams, treasurer.

BEEBE, ARK.—The Beebe Telephone Exchange has changed owners, O. L. Dye selling out to M. Price. Beside the local exchange several interior lines belong to this property.

RIVERSIDE, CALIF.—The Home Telephone Company, which is installing a complete system in Los Angeles, has made application for a franchise to carry on business in Riverside, Calif.

DUNSMUIR, CALIF.—The Electrical Construction Company, of San Francisco, recently installed an inter-communicating telephone system in the Dunsmuir Hotel, Dunsmuir, Calif. It is a central energy system with a Manhattan board.

HAMILTON, CAN.—The formation of the Modern Telephone Company, of Hamilton, Limited, is announced. It has a share capital of $300,000. The provisional directors are: Oscar Wentworth Rogers, Fritz Leoffier, of New York; Staunton King, William Asahel Johnson, Henry Alexander Drummond, Whitford Vandusen, Samuel Clarke Biggs and Joseph Boardman Scovell, all of Toronto.

NEW CASTLE, IND.—The Mount Summit Telephone Company has been incorporated and the capital stock increased from $2,000 to $10,000. The incorporators are: Frank Shiveley, Matt Williams, R. R. Leath, Perry Jeffries and Thomas Rogers.

INDIANAPOLIS, IND.—The Indiana Telephone Company and the Mooreland Rural Telephone Company were incorporated during the week. The capital stock of the former is $560 and the directors are Charles L., N. M. and J. T. Graves. The capital stock of the latter is $10,000. The company will construct a system and operate in Henry, Wayne, Randolph and Delaware Counties, with headquarters at Mooreland.

ROCKFORD, ILL.—The Home Telephone Company announces that unless the unforeseen happens, it will be in working order by August 15.

DAVENPORT, IA.—The Union Electric Telephone and Telegraph Company of Davenport has let contracts to the People's Construction Company for a conduit system in that city.

SHENANDOAH, IA.—The Independent-Mutual Telephone Company has been duly organized, articles of incorporation filed and officers chosen. The board of directors consists of Jas. A. Swallow, president; Fred Fischer, vice-president; C. Brown, secretary; U. G. Reininger, treasurer.

DES MOINES, IA.—The Hawkeye Telephone Company, which has had its headquarters in Perry since its organization, and which has lines reaching over a wide stretch of territory northwest of Des Moines, will remove to Des Moines in about a month and that city will be the headquarters. George N. Bandy, who has recently become general manager of the Mutual here, is president of the company and organized it.

BEDFORD, KY.—The Cumberland Telephone Company is putting in an exchange here. Lines are being extended to all parts of Trimble County.

PERRY, LA.—The Hawkeye Telephone Company is putting in a line from Redfield to Earlham and all the farmers along the line are putting it into their houses.

KITTERY, ME.—The Microphone Transmitter Company has been formed for making and dealing in transmitters, receivers and telephone instruments of all kinds; capital, $500,000. President, Charles C. Smith; treasurer, C. M. Prince, Kittery, Me.

OAKLAND, MICH.—The Oakland and Alma Telephone Companies have completed arrangements for uniting their companies at Holly.

GRAND RAPIDS, MICH.—The annual meeting of the Citizens' Telephone Company has been held. A quarterly dividend of 2 per cent. was declared and the officers and directors were all re-elected as follows: President, Charles F. Rood; vice-president, Edward Fitzgerald; secretary, E. B. Fisher; treasurer, William J. Stuart; Philip Graham, Robert D. Graham, C. E. Perkins, L. J. Rindge, E. G. Studley and J. B. Ware, of Detroit. The report of the secretary showed that the company's system in this State on July 1 contained 10,496 telephones, against 6,963 a year ago; a gain of 51 per cent. Of the increased number 935 were placed in Grand Rapids. The gross income of the company was $198,110.98, out of which $56,804.60 was paid in dividends and $31,000 added to the surplus after paying the running expenses and cost of maintenance of the system. The earnings of the last quarter of the year were in round numbers $16,000 more than for the first quarter. The reports showed that exchanges were established during the year at Ionia, Belding, Diamondale, Sparta, Freeport, Grandville, Cascade Springs and Greenville, and are now being established at Empire, Kingsley and Tustin, while a franchise has been secured at Portland.

MARSHALL, MO.—The Saline County Telephone Company of Marshall has filed articles showing that it had made an increase in its capital stock from $35,000 to $50,000.

SHELTON, NEB.—The Farmers' Home Telephone Company of Shelton has completed its telephone line to Gibbon and is now operating with a list of ninety new subscribers. Since the completion of this line the Nebraska Telephone Company has reduced its rates between these two points from 25 cents to 15 cents for three minutes' talk, while the Farmers' Telephone Company is only 10 cents and time not limited. Arrangements are now being made to connect the new company's lines with the exchange of the Independent Telephone Company of Kearney by August 15. A new company is also formed to run a line from Cozad here, connecting with the Independent company of this city.

GOSHEN, N. Y.—The Warwick Valley Telephone Company has secured the right of way for a line to Amity and Pine Island, and will begin the erection of poles in a few weeks.

TROY, N. Y.—The United Traction Company is about to have put in private telephone service between all of its offices, power stations, storehouses and car barns. An agreement has been entered into with the Hudson River Telephone Company by which the United Traction Company will have direct and exclusive communication between all of its branches. The instruments to be used will be the property of the telephone company. The service will extend through Troy, Watervliet and Albany.

RISING SUN, OHIO.—The Central Union Telephone Company will install an exchange in this place.

CHARDON, OHIO.—The Chardon Telephone Company has increased its capital stock from $10,000 to $25,000.

COLUMBUS, OHIO.—The East Telephone Company of Jefferson County has been incorporated with $6,000 capital stock.

PAINESVILLE, OHIO.—The Painesville Telephone Company is considering buying a new switchboard and other apparatus.

GREEN CAMP, OHIO.—The Marion County Telephone Company has secured a franchise to build a local exchange at Green Camp.

PORTSMOUTH, OHIO.—A contract has been placed with J. A. Grimes of this city for a telephone system at the mines of the Big Fork Coal Company and along the B. & O. Ry.

FINDLAY, OHIO.—The Home Telephone Company has opened its service to Arcadia. A toll station is there. The country line service on the Port Clinton road has also been cut in.

CLEVELAND, OHIO.—It is announced one or two more of the properties of the Federal Telephone Company will be sold out and then the remaining companies will be reorganized under a new head.

COLUMBUS, OHIO.—The Chittenden Hotel Company has closed a contract with the Central Union Telephone Company to install a branch exchange in the hotel with long distance instruments in each of the 275 rooms.

NEWARK, OHIO.—W. H. Crumb & Company, of Chicago, have commenced the work of rebuilding the exchange of the Norwalk Telephone Company. The company's new exchange at Utica started operation August 1.

SPRINGFIELD, OHIO.—A permanent injunction has been secured restraining the Central Union Telephone Company from removing a certain telephone in this place. The company attempted to raise the rate and the subscriber brought suit on the grounds that he was being discriminated against.

AKRON, OHIO.—The Akron People's Telephone Company has declared its first dividend of one per cent., and it is expected that this dividend will be declared quarterly. The company has been meeting with great success and has over 32000 telephones in service, in Summit County. The exchange was placed in operation in June, 1900.

BUCYRUS, OHIO.—Stockholders of the Bucyrus Telephone Company held their annual meeting recently and elected the following: E. Blair, president; J. A. Chesney, vice-president; J. C. F. Hull, secretary-treasurer; A. G. Unger, manager. The company has completed a most prosperous year and 5,000 feet of cable has recently been strung. A line is being built to Sulphur Springs, where three pay stations will be installed.

CLEVELAND, OHIO.—J. B. Hoge, secretary of the United States Telephone Company, announces that the sale of 12,000 shares of the common stock and 2,000 shares of the preferred stock of the company is assured, thus giving the company funds to make needed improvements and extensions. It is claimed that an attempt was made by the Bell people to buy up this stock in a block, but it was all sold to interests friendly to the Everett-Moore syndicate.

NEW RICHMOND, OHIO.—The City and Suburban Telephone Association has just completed the erection of a new exchange at New Richmond, Clermont County. Arrangements are also completed for the opening of an exchange at Milford within a few weeks. Quite a number of long distance lines have been extended into Clermont County and places which for years were isolated as far as telephone connection was concerned, are now connected with the local and long distance lines. At Goshen an automatic switchboard of a dozen lines has been installed.

CLEVELAND, OHIO.—No action has thus far been taken by the Cleveland council in the matter of granting the application of the Cuyahoga Telephone Company for permission to increase rates. The company claims it is losing money on the present rates. It asks permission to increase business rates from $48 to $72 for unlimited service, $48 for two party lines. The present residence rate is $36 and the company desires to increase it to $48 for unlimited service, $36 for two party line and $24 for four party line. The council will investigate the books of the Cuyahoga Company and ascertain what it costs to operate.

READING, PA.—At the Philadelphia and Reading collieries the telephone system is about to be introduced to take the place of the telegraph. One hundred and fifty men are now employed stringing wires and making the necessary changes for the operation of the new system.

EAU CLARE, WIS.—The Ludington Telephone Company has been formed. Capital stock, $3,000. Incorporators: E. G. Ingraham, George M. Hudson, Wesly Baker and others.

KENOSHA, WIS.—The Chicago Telephone Construction Company, at Winthrop Harbor, south of this city, has passed into the hands of a receiver. The receivership was granted on the petition of the Equitable Trust Company of Chicago, and D. F. Foley, general manager of the plant, was appointed receiver. The assets are said to reach $200,000.

ASHLAND, WIS.—The new independent telephone company in Ashland wants long distance connections with the People's Company in Superior and arrangements will be made to accomplish that end this season if possible. C. V. Haymaker is the president of the news company in that city, which recently got a franchise and has already commenced setting poles.

ELECTRIC LIGHT AND POWER.

RANDSBURG, CALIF.—The Mammoth Coal Company has made plans to install a large generator to supply electricity for Randsburg, Calif.

INDIANAPOLIS, IND.—It is now almost certain that the city of Indianapolis will hold the new public lighting contract over until the legislature meets and amends the law so as to provide a ten years' contract. The present charter provides for a one-year contract and it is found that no company except the local company will bid on the contract for one year.

RICHMOND, IND.—The city council has accepted the $300,000 municipal electric light plant erected by the Varney Construction Company of Indianapolis. It will be managed by three commissioners appointed by the mayor. This enterprise has had a stormy time, suit after suit being filed to prevent consummation. The concern is now denominated the "White Elephant."

CRAWFORDSVILLE, IND.—The municipal electric light plant is being operated under a new management and all persons are required to pay monthly. In case of default the current is cut off and a fee of 50 cents charged to get it back. Heretofore, political favoritism played such a part as to allow many delinquents to continue indefinitely in the enjoyment of electric light without pay.

ST. LOUIS, MO.—The West St. Louis Water and Light Company has certified to a paid-in increase of capital stock from $80,000 to $1,000,000. The assets are stated at $80,000 and the liabilities at $1,500,000.

FILLMORE, N. Y.—The Wiscoy Falls, Fillmore, Allegany County, N. Y., are to be developed for the operation of a $25,000 plant for the manufacture of drugs and chemicals by the Signa Chemical Company. The falls, of 75 feet, are thought capable of developing 1,500 horse-power.

STATEN ISLAND, N. Y.—The Richmond Light Company, Borough of Richmond, has been formed; capital, $3,000,000. Directors: Arthur Corlies, Jonathan T. Lauman, Brooklyn; Benjamin R. Seaman, Elizabeth, N. J.; John B. Summerfield, Queens; Robert P. Barry, Jr., New York.

CELINA, OHIO.—The council has appointed a committee to secure estimates on a lighting plant. The probable cost is about $10,000.

COLUMBUS GROVE, OHIO.—The village has issued $15,000 worth of bonds to secure money to purchase the local lighting plant. Improvements will be made.

HUBBARD, OHIO.—The council has decided to call for proposals for the building and equipping of the municipal lighting plant to replace the one destroyed by fire some time ago.

ELYRIA, OHIO.—The Elyria Plumbing, Heating & Electric Company has been incorporated with $10,000 by Edward B. Gale. C. J. Wurst, E. H. Wurst, Nettie Reedy and E. H. Wurst, Jr.

MARION, OHIO.—The Marion Electric Light & Power Company is preparing to make extensive improvements to its power house and system. A new generating set of large size has been ordered.

CLEVELAND, OHIO.—J. A. Erner & Company, of this city, who have the contract for the electrical part of the new lighting plant for the State institution for the blind at Columbus, will install the engine, generator switchboards and a storage battery.

CINCINNATI, OHIO.—Citizens have brought suit against the Cincinnati Gas & Electric Company to test the right of the company to charge what is alleged to be an arbitrary price for electricity furnished consumers instead of calculating the amount by meter and charging at so much per thousand watts.

GOLD HILL, ORE.—An electric light and power plant will be installed near Gold Hill, Ore., for C. Ray, who operates the Braden and the Perry mines. The equipment will include a 200-kw, 3-phase generator to be driven by a water wheel operating under a head of 20 feet. The transmission line will be five miles in length with a two-mile branch. The buildings of the Braden and Perry mines will be lighted and power will be supplied for other mines in the district. The hydraulic development will be sufficient for 3,000-hp to permit of enlarging the electric plant. The dam will be 419 feet in length and 27 feet in height at its highest point.

SUSQUEHANNA, PA.—The Susquehanna County Electric Company has been incorporated; capital, $30,000.

GILMER, TEX.—The Gilmer Electric Light Company has been incorporated at Gilmer, Tex., with a capital stock of $5,000. J. E. Croley, T. C. Mitchel and C. H. Becurr.

SPOKANE, WASH.—The Yakima Water, Light & Power Company will enlarge its plant to double the present capacity. The old canal is to be made wider and deeper and the objectionable flume near the river removed. This is done to make the power plant more permanent.

MILWAUKEE, WIS.—Amendments have been made to the articles of incorporation of the Wisconsin Light, Heat and Power Company, increasing capital stock to $1,000,000.

THE ELECTRIC RAILWAY.

BISBEE, ARIZ.—A company has been incorporated with a capitalization of $50,000 to build a street car line from the smelters near Douglas to that city, a distance of a mile and a half. James Douglas, Jr., C. L. Beckwith, W. H. Brophy and S. F. Meguire are the largest stockholders in the enterprise.

MILAN, ILL.—The Western Illinois Electric Railway Company has been formed; capital, $15,000; incorporators: Franklin E. Caldwell, Robert E. Little and Elmer E. Reynolds.

MUNCIE, IND.—The Muncie, Hartford City & Ft. Wayne Traction Company has increased its capital from $100,000 to $1,000,000.

HUNTINGTON, IND.—The Ft. Wayne & Southwestern Traction Company, operating between Ft. Wayne & Wabash, has doubled the capacity of its power house in this city. It now has two 750-hp engines in service. The company is now contemplating the building of a line from Wabash to Marion by way of Warren.

MUNCIE, IND.—The Union City, Winchester & Muncie Traction Company has been incorporated with $10,000 capital stock to build a line from Union City to Muncie. Dr. J. E. Lowes is at the head of the company and the line will be the Indiana extension of the Dayton & Northern Traction Company, of which Dr. Lowes is president.

LEBANON, IND.—The legal fight between the Indianapolis, Lebanon & Frankfort electric railway company and the Indianapolis and Lafayette Rapid railway company for possession of the right of way from this city east alongside of the Big Four Railroad has resulted in a substantial victory for the Lebanon company. The grading of the latter company's line is completed to Whitestown and a five-acre lot secured for the power house in this city. The power house and the road will be completed this year.

WARSAW, IND.—A franchise for an electric line has been granted by the Warsaw council to the Winona, Warsaw, Elkhart and South Bend Traction Company. The line will connect these places and form a link in the system of the Fort Wayne, Dayton and Cincinnati line, now being built, which eventually will connect with electric lines now running into Chicago from Indiana. The line is for passenger and freight traffic and is to be in operation within eighteen months. George A. Yuille, for several years general manager of the West Chicago Street Railway, will have charge of the construction and equipment of the line.

SIOUX CITY, IA.—It is said the Sioux City Traction Company owning the property of six former companies, has been bought by Swift & Co., the new controlling owners of the Sioux City stockyards, through Col. I. C. Elston, president of the stockyards. Negotiations are also being made, it is said, for the purchase of the Sioux City Gas and Electric Company, owning the monopoly in gas and electric business. The purchase of the two concerns means a $2,000,000 deal. The traction company owns forty-nine miles of street railroad. The capital stock of the company is $1,200,000. The sum of $80,000 has been paid to bind the deal for the purchase of the traction company.

MALDEN, MASS.—A new street railway company has been organized in Malden, to be known as the Maplewood & Danvers Street Railway Company. It proposes to build a line from Eastern Avenue and Broadway, Malden, over the old "Newburyport turnpike," through Saugus, Lynnfield, Danvers and Middleton to Boxford. The capital stock is $190,000 and the directors are: George H. Chase and George F. Marshall, of Malden; Isaac C. Day and Solomon W. Howe, of Boxford; Herbert B. Newton and Edmund B. Fuller, of Haverhill; and William A. Butler, of Georgetown.

OWOSSO, MICH.—Robert Cherry, representing Stephenson Brothers, of Philadelphia, announces that arrangements have been made for financing the Owosso-Durand road and it is probable that construction work will start at once.

KALAMAZOO, MICH.—The Railway Companies General, of Philadelphia, who own the city lines at Kalamazoo and Battle Creek, have decided to make improvements and extensions. Thirty new cars will be purchased for Kalamazoo and twenty for Battle Creek.

MINNEAPOLIS, MINN.—Electric railway construction toward the head of the Lakes is regarded as a certainty at Taylor's Falls. Surveys for the first link, between the Twin Cities at that place are now being made. The survey is for the purpose of locating an electric railway to Taylors Falls and probably to the head of the Lakes. It is well known the route via Taylors Falls and up the St. Croix River is the best between the Twin Cities and Lake Superior.

KANSAS CITY, MO.—The Kansas City Outer Belt and Electric Railroad Company of Kansas City, with a capital stock of $1,500,000, has been chartered. This will give the Stilwell interests of Kansas City a connecting railroad. The road is to extend around Kansas City and in Kansas City, Jackson and Clay Counties, and is to be eight miles long. The stockholders and promoters are A. E. Stilwell, E. E. Holmes, Ben Schnierle and Bennett N. Simpson.

CONCORD, N. H.—The Railroad Commissioners have granted the incorporators of the Newport and Sunapee Electric Railroad the right to issue $60,000 of stock and the same amount of bonds to meet the cost of construction, and the contracts for the work of building and equipping the line will be let immediately. The road will be seven miles long, one of its termini being Lake Sunapee.

ATLANTIC CITY, N. J.—The Atlantic City and Surburban Traction Company has been formed. Principal office, Atlantic City, N. J.; object, transportation; capital, $500,000. Incorporators: Edward R. Spensler, Harrisburg, Pa.; C. Taylor Leland, Philadelphia, Pa.; and Albert M. Jordan, Atlantic City, N. J.

OSSINING, N. Y.—The board of highway commissioners has granted a franchise to the Westchester Traction Company, which bought the local trolley line, to run its road to the town line of the town of Ossining, in the W. W. Law farms, on condition that it will be completed in six months. This is on the proposed extension to Pleasantville. The grant covers about two miles and is mostly along a private right of way. The rest of the way to Pleasantville is through the town of Mount Pleasant.

ROCHESTER, N. Y.—Two suburban trolley lines, the Rochester & Sodus Bay and the Rochester & Irondequoit Park, have been consolidated for business reasons. A year ago the Sodus line took a lease for 999 years of the old Glen Haven Road and these two lines have been merged under the title of the Rochester & Sodus Bay Railroad, with a capital stock of $1,850,000. The directors are: T. J. Nicholl, G. G. Morehouse, Rochester; C. A. Burbank, Joseph E. Buckley, New York; D. W. Gibbs, Montclair, N. J.; John L. Lockwood, Roseland, N. J., Arthur C. Vaughan, Garden City, N. J.

ALBANY, N. Y.—The Vermont and Whitehall Railway Company, with principal office in New York City, has been incorporated with a capital of $500,000 to operate an electric street railroad, nine miles long, from the Delaware & Hudson depot in Whitehall, to the Vermont State line, to intersect the proposed route of the Rutland Street Railway. The line lies in Washington County. The directors are: Daniel A. Slattery, J. Osgood Nichols, K. C. Morhous, Paul M. Mowrey, Leroy W. Baldwin, Harry M. Gough, Clinton E. Breaine, Donald K. Brown, and Ezra A. Tuttle, of New York City.

YOUNGSTOWN, OHIO.—The Youngstown & Sharon Railway Company will shortly install a telephone system over its entire road.

CINCINNATI, OHIO.—The Cincinnati, Georgetown & Portsmouth Railroad, formerly a steam road, is now being changed to electric power.

TOLEDO, OHIO.—The Toledo, Bowling Green & Southern Traction Company is erecting a temporary power station at Cygnet. A 300-hp unit is being installed.

CANTON, OHIO.—The Canton-Akron Railway Company has closed a deal for extensive frontage on Springfield Lake near Akron and it is the intention to erect a hotel and pavilion.

MIDDLEFIELD, OHIO.—At a meeting of citizens of Vernon, Orangeville and Kinsman final steps were taken to insure the construction of an electric line from Middlefield, Ohio, to Sharon, Pa.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company, which is preparing to extend its line from Garrettsville to Leavittsburg, will erect a new storage battery station between the two towns.

YOUNGSTOWN, OHIO.—The county commissioners have granted a 50-year franchise to the Mahoning Valley, Southwestern Railway Company for its proposed line to Struthers. The line is to be built at once.

CINCINNATI, OHIO.—Bids have been received and contracts will be awarded in the near future for the erection of the new interurban terminal station on Sycamore Street. The estimated cost is $75,000.

CLEVELAND, OHIO.—Holcomb & Lattimer, promoters of the Cleveland, Painesville & Ashtabula Railway, have accepted the franchise granted in Geneva. The road is to be completed and in operation by July 1, 1903.

AKRON, OHIO.—The Northern Ohio Traction Company will apply to the city council for a renewal of the city lighting contract. The company has made numerous improvements to its plant to take care of the growth of the city.

NEWARK, OHIO.—The Newark & Granville Railway, which was recently consolidated with the Columbus, Buckeye Lake & Newark Traction Company, is being thoroughly rebuilt. New rails are being laid and new cars will be installed.

YOUNGSTOWN, OHIO.—The council has passed an ordinance granting a franchise to the Mahoning Valley Railway Company to build a line the entire length of Mahoning Avenue. The ordinance was bitterly contested by residents along the route.

FOSTORIA, OHIO.—An oil well drilled on the right of way of the Toledo, Fostoria & Findlay Railway is flowing 100 barrels a day. Other wells will be drilled. There is just room for the cars to pass without grazing the edge of the derrick.

CLEVELAND, OHIO.—Universal transfers, seven tickets for a quarter; nine hours and good wages for employees, are the terms which the United Trades and Labor Council will ask the city council to consider in exchange for a general extension of all street railway franchises.

DAYTON, OHIO.—Officials of the Appleyard syndicate have decided to give Springfield the go-by and erect the new cars, barns and repair shop for the Dayton, Springfield & Urbana Railway at Dayton. The structure will cost about $50,000. R. G. Gotwald, of Springfield, is preparing plans.

WESTON, OHIO.—The Toledo, Columbus, Springfield & Cincinnati Railway Company has commenced work at Weston on a section of 21 miles running south of town, along which entire right of way has been secured. As soon as track is laid, the road will be operated temporarily by steam motor cars.

CINCINNATI, OHIO.—H. H. Kirkpatrick, of Jonesboro, Tenn., is to buy material for a line to be built between Jonesboro and Johnson City. The project has been financed by a syndicate headed by Wilfred Jessup, of Richmond, Ind. A large national soldiers' home is to be built between the towns mentioned.

BUCYRUS, OHIO.—The Ohio Central Traction Company proposes to use nothing but old cars on the Bucyrus end of the line because the town will not permit the company to put in a loop so that cars can be turned. The company has just received several new interurban cars from the St. Louis Car Company.

MANSFIELD, OHIO.—The Citizens' Electric Railway, Light & Power Company, which owns the city lines and the Shelby-Mansfield Railway, has placed an order with the Phœnix Electric Company, of Mansfield, for a new 300-kw generator. Other improvements are to be made at the power station of the company.

CONNEAUT, OHIO.—The Conneaut & Southern Railway has obtained a franchise to build into the center of the village. C. Chapman, the promoter, claims that the work will start by September, 1902. The right of way from Conneaut to Youngstown has been obtained. The power house will be located at Andover.

COLUMBUS, OHIO.—The Columbus, Delaware & Marion Railway has commenced work on its line north of Delaware. It has been decided to build by way of Prospect and it is quite probable that a spur line will be built to take in Richwood and Magnetic Springs. Rails are being received for the northern extension.

CLEVELAND, OHIO.—The Muncie, Hartford & Ft. Wayne Traction Company, which is owned largely by Cleveland people, has increased its capital stock from $100,000 to $1,000,000. The road is now being built between Muncie and Hartford and will be extended to Ft. Wayne as soon as the first section is completed.

YOUNGSTOWN, OHIO.—Park & Hamilton, contractors, have commenced the work of building the extension of the Pennsylvania & Mahoning Valley line along the south bank of the Mahoning River to Struthers, the ultimate intention being to extend to Poland. The company already operates to Struthers on the north side of the river.

CONNEAUT, OHIO.—The promoters of the Conneaut & Eastern Railway announce that on account of the inability to secure rails, nothing can be done on the line this fall except to build the power house. Sixteen miles of rails have been secured to complete the line between Erie and Girard and the balance will be built next year.

YOUNGSTOWN, OHIO.—Contracts have been awarded to E. M. Scofield Company of New York for the erection at Hasleton of large car barns and power house for the new extension of the Pennsylvania & Mahoning Valley Railway. The car barn will be a steel structure and it will cost about $40,000. Work will commence at an early date.

CLEVELAND, OHIO.—The Everett-Moore syndicate is planning to double track the Lake Shore Electric Railway between Cleveland and Lorain. The business of this section of the road is developing rapidly and at times it is necessary to operate fifteen-minute service. When the freight business opens up the line will be more crowded than ever.

TOLEDO, OHIO.—Work is to be started at once on the extension of the Toledo & Monroe Railway from Monroe to Detroit over right of way secured when the road was originally laid out. A supply of rails has been secured for immediate delivery. The line will be independent of the Detroit & Toledo Shore Line, the fate of which is still undecided.

OBERLIN, OHIO.—Unknown parties are securing a right of way between Oberlin and Lorain. It is believed that the Everett-Moore syndicate is back of the project with a view of building a branch line. It is claimed that passengers could go to Cleveland considerably faster over this route than by way of the Cleveland, Elyria & Western.

FREMONT, OHIO.—A. H. Jackson and B. R. Dudrow, promoters of the proposed Fremont-Sandusky Railway, are meeting with unexpected success in securing right of way, practically no one opposing the project. The power house will be located on Sandusky Bay and a pleasure resort will be located adjoining. Franchises in the two cities will shortly be asked for.

COLUMBUS, OHIO.—The Central Market Street Railway Company has increased its capital stock from $500,000 to $1,500,000. Three-fourths of the amount of increase is in preferred stock. S. B. Hartman is president and F. W. Merrick, secretary of the company, which was formed to operate the city portion of the interurban lines owned by the Appleyard syndicate.

MANSFIELD, OHIO.—The Mansfield, Wooster & Canton Traction Company has been incorporated with $10,000 capital stock to build a line from Mansfield to Canton by way of Wooster, a distance of about 60 miles. George H. Billman, J. H. Sigler, J. M. Downey, M. S. Abel, George H. Taylor and M. S. Abel, of Cleveland, are the promotors. James Ritchie formerly city engineer, of Cleveland, is making the surveys.

CLEVELAND, OHIO.—The new road which is projected to extend from the Middlefield terminus of the Eastern Ohio Traction Company's road to Sharon, Pa., will be known as the Cleveland & Sharon Railway, temporary organization having been effected. Much of the right of way has been secured and citizens of the various towns along the route have agreed to subscribe to the bonds of the company. The promoters are Cleveland and New York people.

CLEVELAND, OHIO.—The Everett-Moore holdings in the Scioto Valley Traction Company, amounting to 60 per cent. of the capital stock, have been sold to Cyrus Huling and other Columbus parties who have been interested in the project. The road is being built from Columbus to Circleville and from Columbus to Lancaster. Construction will now be pushed as rapidly as possible. The only change in the organization will be the retirement of Barney Mahler as president and Messrs. Everett and Moore as directors.

CINCINNATI, OHIO.—The Cincinnati & Northwestern Traction Company has been incorporated with $15,000 capital stock by Judge Dennis Dwyer, Albert Emanuel, C. F. McCrea, C. L. McCrea and E. M. Hopkins. It is proposed to build a line from Cincinnati to Dayton, and a deal has been closed whereby the company secured a private turnpike leading out of Cincinnati 15 miles to Bond Hill, Reading and Sharon. The promoters decline to state who are backing them; but they claim the Appleyard syndicate, which is seeking entrance to Cincinnati, is not interested.

CINCINNATI, OHIO.—Officials of the Cincinnati, Milford & Goshen Traction Company announce that construction work on the line will start August 15. The road will be built along the turnpike and will be double track as far as Milford; it will be 20 miles long. Those interested are B. H. Rannels, W. C. Compton, W. A. Goodman, Eugene Barney and J. L. Zimmerman. Mr. Barney is a member of the Barney & Smith Car Company, Dayton, and Compton owns the turnpike over which the line will be built. It is stated that a company headed by Senator Roudebush is securing private right of way for a line over a similar route.

TORONTO, ONT.—Thomas L. Childs, of Akron, who has promoted several roads in Ohio, represents Cleveland capitalists who propose to build a line from Toronto to Hamilton, a distance of 50 miles. A charter has been granted for a line between these two cities and the impression is that the Cleveland people will attempt to construct their line under it. The route is considered one of the most desirable in Canada.

LATROBE, PA.—It is said that the Latrobe electric road will be extended to Derry as that town is enjoying a boom. The road, it is also said, may cross the Loyalhanna at Youngstown, pass through Baggaley and Whitney and come into West Latrobe by way of Dorothy and St. Vincent.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has closed a contract with the Chattanooga Light and Power Company to furnish a large amount of additional power, which has been rendered necessary by the increase in the number of lines of the Electric Railway Company.

THE AUTOMOBILE.

INDIANA AUTOMOBILE LINE.—Rhodes Bros. have organized a company to establish an automobile line between New Albany and Vincennes. The new autos will carry 16 persons each and will displace the old time "Deadwood" stage coaches that have been carrying passengers between these points for many years.

NEW YORK-BOSTON RUN.—The committee of the Automobile Club of America in charge of the proposed 500-mile reliability run, from this city to Boston, has fixed on Thursday, Oct. 9, for the start of the trip. The route will be via Norwalk, Bridgeport, New Haven, Hartford, Springfield, and Worcester, arriving in Boston on the afternoon of Saturday, Oct. 11. Sunday will be spent in Boston, the start on the return trip being made on Monday morning, Oct. 13, over the same route, arriving in New York on Wednesday afternoon, Oct. 15. Each vehicle will carry an official observer, who will be provided by the club, and the run will be open to all classes of self-propelled vehicles made either in the United States or abroad.

NEW INDUSTRIAL COMPANIES.

THE SIMPLEX ELECTRIC HEATING COMPANY has been formed. George U. Crocker, president; C. A. Morss, Jr., treasurer; capital, $80,000.

THE HUGHES TELEPHONE MANUFACTURING COMPANY, of Baltimore, has been incorporated to manufacture telephone supplies, etc.; capital, $100,000.

AMERICAN FIRE EXTINGUISHER COMPANY has been formed under the laws of New York by L. A. Richter, J. C. Blanche, and E. R. Huckel, with a capital stock of $100,000.

THE HARRISON WILLIAMS COMPANY, Toledo, Ohio, has been incorporated under the laws of Delaware with $200,000 capital stock to manufacture railway and electric railway supplies.

DIAPHRAGM STORAGE BATTERY COMPANY has been formed under the laws of New York with a capital stock of $10,000. The directors are J. H. Robertson, E. Edwards and G. Wexler, of Brooklyn.

BLANCHE FIRE ALARM COMPANY, of New York City, has been founded under the laws of Delaware to make and sell thermostats under the patents of Joseph C. Blanche, with a capital of $50,000.

H. W. McCANDLESS & COMPANY, to be interested in electrical lamps, has been formed under the laws of New York with a capital stock of $10,000. Directors: H. W. McCandless and J. E. McCandless, of Orion, Ill.

THE AUTOMOBILE RENTING COMPANY, of St. Louis, has been incorporated with a capital stock of $2,000, all paid. The incorporators are Harry S. Turner, Jr., Max R. Orthwein, Ralph H. Orthwein and others.

THE WARREN LIGHT AND MANUFACTURING COMPANY, of Minneapolis, Minn., has been formed; capital, $10,000; incorporators: Benjamin Warren, Jr., and L. H. Murray, of Peoria, Ill, and J. B. Christian, of Minneapolis.

THE ELECTRIC SIGNAL COMPANY, which has been incorporated in Arizona with a capital stock of $30,000,000 by P. A. McClain, H. H. Hallowell and J. C. Foering, of Philadelphia, proposes to do a general electrical business, making a specialty of electric signals for railroads.

THE GENERAL ELECTRICAL INSPECTION COMPANY 'to prevent electrical fires is being formed with these officers: President, Charles H. Simmons; vice-president, T. P. Gilvan; general manager, F. M. MacDonald; secretary, H. Hardy; treasurer, George M. Hard; electrical engineer, Charles E. Knox.

THE MISSISSIPPI VALLEY AUTOMOBILE COMPANY, manufacturers, filed articles of incorporation last week. The paid-in capital stock of $48,000 consists of 480 shares, valued at $100 each. Harry S. Turner, Jr., holds 240 shares, Max R. Orthwein 162, Ralph H. Orthwein 48, H. M. Coudrey 10, Geo. A. Myer 10, and Henry Koehler, Jr., 10.

LEGAL.

LANCASTER, OHIO.—Edmund Dickey, a director of the Consumers' Carbon Company, has brought suit to restrain Charles Britton *et al.* from issuing $60,000 of treasury stock.

HAVANA LIGHTING.—The Spanish-American Light and Power Company has appealed to the Supreme Court at Havana, Cuba, asking that body to declare null the resolution of the Council of Secretaries to the effect that the Secretary of Public Works is the proper one to decide in the matter of a concession to Señor Castaneda for the construction of an electric plant. The President of the Supreme Court has decided that, though the Constitution of Cuba gives the Supreme Court power to decide questions of constitutionality, it also speaks of a law regulating the organization of and powers of courts and the method of their exercising their functions, which law has not yet been made; and that, therefore, it cannot enter into a matter such as the one brought before it until the law shall have been made.

PERSONAL.

MR. HORACE PORTER, for some time assistant superintendent of the Cincinnati Traction Company, has become superintendent of the street railway at Paducah, Ky.

MR. M. A. OBERLANDER, purchasing agent of the Western Electric Company, New York City, is taking a long needed rest by the enjoyment of a few weeks' vacation at the Thousand Islands.

MR. O. E. OLESON, for six years chief engineer of the power plant of the Toledo Railways & Light Company, has resigned to accept a similar position with the Rapid Transit Company, of Minneapolis.

MR. EDWARD SPELLMAN, of Cleveland, has been appointed superintendent of the Ohio Central Traction Company's lines, which are the property of the Pomeroy-Mandelbaum syndicate of Cleveland.

MR. H. B. CAMP, vice-president of the Cleveland, Richfield & Akron Traction Company, has resigned his position because he claims it is not possible to secure a franchise from the council of Akron without the liberal use of money, to which he declines to be a party.

MR. T. GRAHAM LITTLEBOY, M. I. E. E., of Brymbo, England, who has been for several weeks at Sydney, Cape Breton, installing an important plant of special electrical apparatus, has visited New York the present week, and will look up electrical matters while in the United States.

MR. J. C. BENNETT, auditor of the Westinghouse Electric & Manufacturing Company of East Pittsburg, sailed for England recently on business connected with the British Westinghouse and Electric Manufacturing Company. Mr. Bennett was given a dinner by his office force as a "send-off."

MR. C. J. GLIDDEN and his wife are now traveling through Europe in their latest automobile, the termini of the trip being London and Venice. The round trip, never going twice over the same ground, will cover 3,820 miles. Mr. Glidden is as enthusiastic an automobilist as he once was a telephonist.

MR. F. W. WEISS, formerly of the firm of Jalden, Walker & Weiss, New York City, has, since its dissolution, established himself in offices at 123 Broadway, where he will continue the practice of corporation, commercial and legal accounting in all its branches. Mr. Weiss is very well known in the electrical and street railway field.

MR. H. E. CHACE.—The appointment has been made of Horace E. Chace to the position of assistant superintendent of telegraph for the Atchison, Topeka and Santa Fe Railroad systems to succeed Mr. Andrew Smith, deceased. He will be in charge of the telegraph system of the railroad on all lines west of Albuquerque.

MR. HUGH J. McGOWAN, president of the Indianapolis Street Railway Company, has subscribed $10,000 to the fund now being raised to secure a national technical institute in that city. Mr. McGowan says that if young men receive the necessary training to fit them for a place in the commercial and mechanical world the social problem will be solved.

MR. C. O. BAKER, JR., has been appointed, with his brother, residuary legatee of his uncle, Mr. C. O. Baker, the banker, of Newark, who died recently leaving a very large estate. A Baker memorial fund is created, and there are some 38 specific personal and charitable bequests ranging from $1,000 to $60,000. It is understood that the remainder of the estate will reach a considerable figure.

Trade Notes.

CINCINNATI, OHIO.—The Ritter Electric Company of Cincinnati has increased its capital stock from $15,000 to $50,000. John C. Mulvihill is president and C. A. Hofling, secretary of the company.

BULLOCK ELECTRIC MANUFACTURING COMPANY'S ornamental calendar card for August bears an excellent portrait of Werner von Siemens, and on the back is a succinct sketch of his career.

TECHNICAL ADVERTISING.—Mr. Ray D. Lillibridge, who prepares and handles the advertising for a number of well-known concerns, has just issued a neat and pithy circular devoted to his business and announcing his change of address to 170 Broadway, New York City.

WARREN, OHIO.—The Colonial Electric Company has completed its annual inventory and the factory has been put into shape to take care of increased business. The fan department has been unable to keep up with its orders and the advance orders for incandescent lamps indicate another very busy season in that line.

THE CHAPMAN LIGHTNING ARRESTER for telephone and telegraph lines is a new efficient and thoroughly reliable type of arrester for the protection of instruments, poles and other property. The Electric Appliance Company, Chicago, are sending out circulars illustrating and describing it, and which they will gladly mail upon application.

LATHBURY & SPACKMAN, of Philadelphia, inform us with regard to our recent article on the Alsen American Cement Works on the Hudson, that they were the engineers of this interesting plant. We are glad to note this fact and to give them the credit due for a notable power installation, which was made under their plans, specifications and supervision.

BUFFALO FORGE COMPANY, of Buffalo, N. Y., have just issued a new edition of the catalogue on their improved ventilators. The previous catalogue is exhausted and the new one is likely to be in as large demand. The data is presented interestingly and clearly, and the apparatus has qualities of great merit.

THE AUTOMOBILE & CYCLE PARTS COMPANY, of Cleveland, Ohio, will, after Aug. 1, transact business under the name of the Federal Manufacturing Company. The change in title will not in any way affect the management of the company or the business of its factories. The products of the company's factories are so diversified that a more comprehensive name became necessary; hence the change.

THE CHICAGO FUSE WIRE & MFG. COMPANY state that since offering their souvenir paper weight a few months ago, this little article has come to be in great demand and they have sent out already a great number of them on requests from their customers; also that they have had a large number of requests from others on their proposal to send this article for 10 cents to cover postage and packing. This company reports a steadily increasing demand for their popular line of fuse wire and links and telephone supplies.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 28, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

705,549. SIGNAL DEVICE; H. S. Balliet, Bethlehem, Pa. App. filed April 10, 1902. An electric fan is put inside of a signal box and kept running, to prevent the deposit of moisture or dust upon the instruments.

705,558. ELECTRIC CLOCK; J. Butcher, New York, N. Y. App. filed Oct. 16, 1901. Details of the circuit closing apparatus.

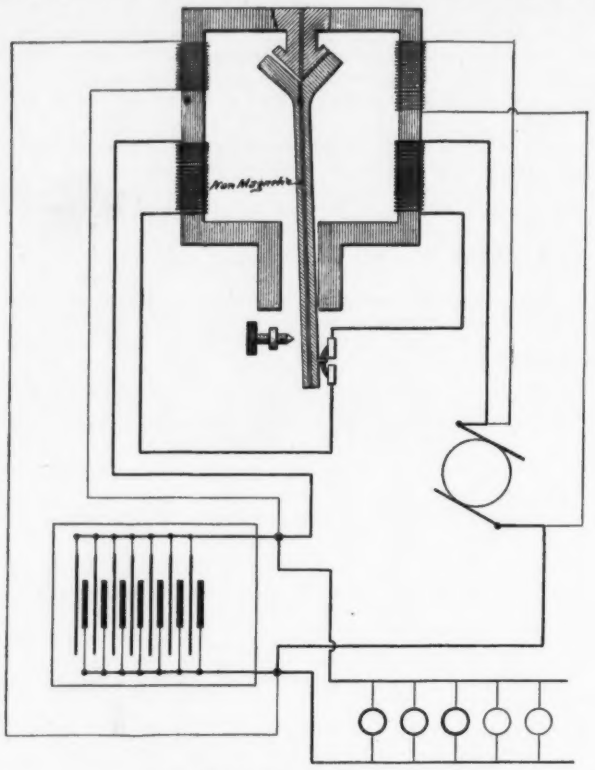
705,561. RHEOSTAT; William H. Chapman, Portland, Me. App. filed Dec. 14, 1901. The segments are very thin plates set on edge and insulated so as to occupy the smallest possible linear space, for the travel of the contact.

705,583. ELECTRIC SIGNAL; A. J. Haycox, Mansfield, Ohio. App. filed April 10, 1902. A signal lamp, one terminal of which is connected with the trolley wire, while the other leads through a hand switch to the return.

705,584. SIGNAL MECHANISM; Reinhold Herman, Crofton, Pa. App. filed Oct. 25, 1901. Details.

705,597. ELECTRIC SIGN; Thomas E. Murray, New York, N. Y. App. filed Feb. 11, 1902. Each socket is formed with a flange which is secured by screws to the front plate of the sign.

705,616. GALVANIC BATTERY; Charles B. Schoenmehl, Waterbury, Conn. App. filed Dec. 1, 1900. The elements are held fixably in position in the cell by rigid arms attached to the cover and by making the zinc in the form



705,786.—Automatic Switch.

of a cylinder and forcing it towards the side walls of the cell by means of a spring ring, the depolarizer being in the space between the cylinder and the cell walls.

705,630. SEPARATOR FOR ELECTRIC ACCUMULATION PLATES; Richard Alexander Katz, Berlin, Germany. App. filed Oct. 18, 1901. A double grid in which the bars of one cross the spaces of the other.

705,651. REDUCTION OF METALS FROM THEIR ORES, ETC., IN ELECTRICALLY HEATED FURNACES; R. C. Contardo, Sevres, France. App. filed Dec. 1, 1897. (See page 218.)

705,662. ELECTRIC SIGNAL FOR RAILWAY CABS; Joseph W. Frost, Washington, D. C. App. filed Jan. 25, 1902. The signal instruments are in a local circuit on the cab, which is controlled by a relay in a circuit shunting the car motor.

705,668. ELECTRIC HEATER; William S. Hadaway, Jr., New York, N. Y. App. filed Sept. 24, 1898. A plate having an upwardly turned flange all around; a heater suitably insulated on the bottom of the plate, and a cover plate deposited upon the insulation and held by the overturned flange.

705,685. TELEPHONY; J. Lyons, Charmian, Pa. App. filed Sept. 2, 1899. (See page 219.)

705,686. TELEPHONY; J. Lyons, Washington, D. C. App. filed April 23, 1902. (See page 219.)

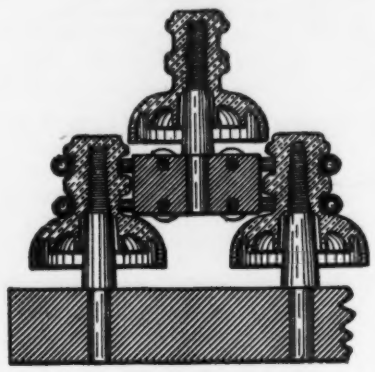
705,727. METHOD OF TREATING METALLIC OXIDS IN THE PRODUCTION OF METALS AND ALLOYS; F. C. Weber, Chicago, Ill. App. filed April 15, 1901. (See page 218.)

705,773. DEVICE FOR LIGHTING LAMPS BY ELECTRICITY; S. M. Meyer, Brooklyn, N. Y. App. filed Jan. 3, 1898. Details.

705,786. AUTOMATIC SWITCH; Herman A. Poppenhusen, Evanston, Ill. App. filed Oct. 31, 1901. In a system wherein a storage battery is charged from a dynamo the automatic switch carries two coils, one in a shunt to the battery, and the other in a shunt across the dynamo. When the voltage of the battery exceeds that of the dynamo the main circuit is opened.

705,798. TROLLEY; William L. Von Hardenburg, Brooklyn, N. Y. App. filed June 22, 1901. A specific construction of that type of trolley wheel in which a spiral groove leads from the hub to the tread of the wheel so that the displaced trolley wire will be returned to its proper position.

705,802. CABLE TERMINAL BOX FOR ELECTRICITY SUPPLY PURPOSES; George Wilkinson, Harrowgate, England. App. filed April 21, 1902. The ends of the cable and the ends of the service conductors are in the form of discs strung upon a core suitably insulated from each other where necessary and held in proper contact by spring pressure.



705,811.—Insulating Support for Metallic Circuits.

705,805. ELECTRIC ANNUNCIATOR; William R. Winter, Trenton, N. J. App. filed Nov. 15, 1901. A non-interfering signal box.

705,811. INSULATING SUPPORT FOR METALLIC CIRCUITS; John Scott Allen, Los Angeles, Cal. App. filed Nov. 30, 1902. Two knob-insulators set upon the cross arm support between them a block upon which a third insulator is mounted, the latter carrying the wire.

705,825. TROLLEY HEAD AND WHEEL; Walter A. E. Davis, Toledo, Ohio. App. filed Dec. 18, 1901. Details.

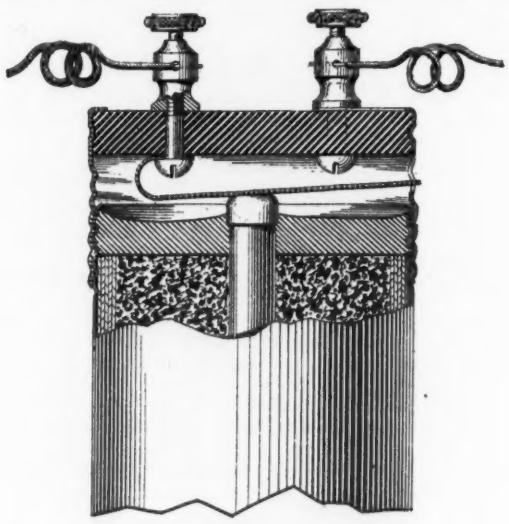
705,848. ELECTRIC RAILWAY; Charles J. Kintner, New York, N. Y. App. filed Feb. 28, 1902. A switch journaled with its axis of rotation parallel with the track rails and provided with means for adapting it to be rotated gradually and continuously about its axis as a car passes over it.

705,850. ELECTRICAL PANEL BOARD; Hubert Krantz, Brooklyn, N. Y. App. filed March 12, 1902. A protecting cover over the board is provided with openings through which the handles of the several switches project.

705,854. GENERATING APPARATUS FOR CAR LIGHTING; Albert F. Madden, Newark, N. J. App. filed Feb. 24, 1902. The dynamo is flexibly mounted and carries a friction pulley; another friction pulley on the axle is connected with the first mentioned by a third friction pulley mounted on the end of a movable link.

705,882. TROLLEY; Thomas W. Sutton, Pittsburg, Pa. App. filed May 7, 1902. Details of a device for preventing a wheel from leaving the wire.

705,919. ELECTRIC BATTERY; Edwin R. Gill, New York, N. Y. App. filed Nov. 15, 1901. The upper end of the zinc cylinder of a dry cell is screw



705,919.—Electric Battery.

threaded to receive a cap which carries the binding posts and makes ready contact with the poles of the battery when it is applied thereto.

705,935. MAGNETIC CORE FOR INDUCTANCE COILS; J. C. Lee, Brookline, and E. H. Colpitts, Boston, Mass. App. filed Nov. 30, 1901. (See Current News and Notes.)

705,936. LOADED ELECTRIC CIRCUIT; J. C. Lee, Brookline, and E. H. Colpitts, Boston, Mass. App. filed Nov. 30, 1901. (See Current News and Notes.)